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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Americania.

We are always fascinated by the Papers presented to the American Foundrymen's Association as they reflect in no uncertain manner, the existing state of the art and the trend of foundry thought in that great Continent. The impression that is given is that in general, the brains controlling American foundry work are more closely associated with an engineering mental make up, whilst here the tendency appears to be to align themselves with metallurgical thought. A second impression is that the American foundry industry suffers, as does ours, from a section of the smaller owners still adhering (probably under pressure from the buyers) to an antiquated system of invoicing castings on a weight-range basis. In this issue Mr. J. J. Ewens makes a strong appeal on definitely logical grounds for its complete suppression. A factor which always finds prominence in their Proceedings is "materials handling," and in connection with this we note that the figure of 100 tons of transported material to make one ton of castings has now gone by the board, only to be replaced by a still higher figure. Now, we on this side seem to be a little nervous of accepting communications of this character, as the major proportion of engineers capable of adequately dealing with the question, have (paradoxically) unfortunately and fortunately something to sell for the amelioration of existing conditions. We have on several occasions spoken with prominent American foundrymen as to their attitude when the reader of a Paper of this kind oversteps the bounds of decency and uses the occasion for pronounced advertising. "Wholesale snubbing" has been the answer invariably returned. Another phase of foundry practice invariably discussed at length is sand preparation. Here an economic basis exists, because being a large Continent, transport- costs may and do prohibit the general use of the universally-recognised best resources. Even in Great Britain it is a factor to be reckoned with, and the value of more than one important deposit would be greatly enhanced but for its geographical situation.

An interesting feature of their work is the effort some are making to put runners and risers on a more rational basis. We do not remember any communication on this subject being given to annual meetings of the British Institution except as an incidental. We wonder whether the American Foundrymen's Association would have accepted a thesis such as was recently presented to American Society for Testing Materials on "A Study of Centrifugally-Cast Pipe versus Sand-Cast Pipe"? To our mind this type of communication is—from a metallurgical point of view—a waste of time, because the properties of the two materials are exactly in line with their composition and thermal history. Moreover, such a study is liable to detract attention from realities by creating a mental bias through utilising sporting phraseology.

Industrial Goodwill.

Much ink has been spilt during the past seven years over the topic of rehabilitation of British trade and the importance in this connection of good-will in industry. Recognising that, while much has been said, little has as yet been done, the Glasgow and West of Scotland Association of Foremen, Engineers and Draughtsmen conceived the very praiseworthy idea of offering an award for a Paper which would put forward the most practical and the most readily applicable proposals for promoting goodwill in industry. It was laid down as a *sine qua non* that the papers should be based upon actual industrial experience and capable of actual industrial application, and theories, whether academic, political or sociological, were to be taboo.

Those in the founding industries will be interested to learn that the award has been made, by the unanimous decision of the judges, to Mr. J. G. Pearce, well known as Director of the Cast Iron Research Association. Their congratulations will be the warmer for the satisfaction of knowing that in a question of such vital importance to British trade, the winner is so closely connected with the foundry trade.

The interesting feature of the competition was the character of the judges, for the Association was at once well advised and fortunate; technical societies are apt to do so little outside the ordinary run of their regular activities that the peculiar value of this action will be realised. Sir Archibald Denny, the veteran shipbuilder, late President of the Institution of Civil Engineers, and widely known as the chairman of the British Engineering Standards Association, represented what might be termed the employer interest. Mr. J. T. Brownlie, well known as the president of the Amalgamated Engineering Union, represented what might be termed the employée interest, and the so-called third party in industry, the technical and administrative grades, was represented by a member of the Glasgow Association, Mr. John Holloway.

The value of the unanimous award at once becomes apparent, for proposals which are equally acceptable to the three parties clearly stand a chance of being acceptable to the country as a whole. The award is, moreover, a testimony to the ability of the trained mind to understand, interpret, and reconcile interests which are so often superficially conflicting while fundamentally at one. The administrator in industry, whether technical or non-technical, is in a key position, for in a real sense he holds the scales between the other two parties. If there is confidence in his integrity and good intentions, the path to industrial understanding is so much the smoother.

Many of our readers will no doubt wish to have an opportunity of studying the proposals in question, but we understand that it has not yet been decided how they will be put forward—whether at a public meeting or by publication. They will, in any case, be the fruit of careful thought applied to a good deal of first-hand industrial experience. It is not infrequently said that the technical man is the only man to-day who has anything to say, and he is the only man who does not know how to say it. Here it would appear that we have the exception that proves the rule.

XUM

The Institute of Metals.

AUTUMN MEETING IN LIVERPOOL.

As previously announced, the Autumn Meeting of the Institute will be held in Liverpool from September 4 to 7, by kind invitation of the local members of the Institute. Already about 200 persons have indicated their intention to take part in the meeting. An influential Reception Committee has been formed under the chairmanship of Professor C. O. Bannister. The following programme has been arranged:—

TUESDAY, SEPTEMBER 4.

2.30 p.m. to 10 p.m.—The office of the Hon. Local Secretary, Mr. H. F. Richards, will be open at the Adelphi Hotel for the issue of tickets, etc., and for general information.

8 p.m.—Seventh Autumn Lecture, by Mr. F. G. Martin, B.Sc., F.I.C., on Non-Ferrous Metals in the Shipping Industry, in the Arts Theatre, The University, Brownlow Hill.

7.30 p.m. (Ladies).—The ladies of the party will be entertained at the Playhouse Theatre (Repertory) by the Ladies' Committee.

WEDNESDAY, SEPTEMBER 5.

9 a.m. to 1 p.m.—The office of the Hon. Local Secretary will be open as above.

10 a.m.—General meeting of members at the Adelphi Hotel. A civic welcome will be given to the members by the Lord Mayor of Liverpool, Miss Margaret Beavan. A selection of Papers will be presented in abstract and discussed.

10 a.m.—Ladies not attending the general meeting will meet at the Adelphi Hotel, leaving for visits to (*a*) Messrs. W. & R. Jacob & Company's biscuit factory, or (*b*) the Liverpool Cathedral, returning to the Adelphi Hotel, where, at

12.30 p.m. a group photograph of members and their ladies will be taken after the general meeting has been adjourned until the following day.

1 p.m.—Members and their ladies will be entertained at luncheon in the Adelphi Hotel by the local members and industrial and other firms.

2.30 p.m.—Members and their ladies will proceed to make the following visits:—(*a*) Messrs. Thos. Bolton & Sons, Limited, Mersey Copper Works, Widnes, and Messrs. High Speed Steel Alloys, Limited, Widnes; (*b*) Messrs. British Insulated Cables, Limited, Prescot; (*c*) Messrs. Cammell Laird & Company, shipbuilders, Birkenhead; (*d*) Messrs. Lever Bros., Limited, Port Sunlight; (*e*) Messrs. The Penpoll Tin Smelting Company, Limited, Bootle; (*f*) Messrs. Rylands Bros., Limited, wire manufacturers, Warrington; (*g*) visit to s.s. Oxfordshire, Mortar Mill Quay, Birkenhead, by invitation of Messrs. Bibby Bros. & Company.

7.30 p.m.—Members and their ladies will assemble at the Adelphi Hotel for an entertainment and dance arranged by the Local Committee. Supper will be provided. (Evening dress.)

THURSDAY, SEPTEMBER 6.

9 a.m. to 1 p.m.—The office of the Hon. Local Secretary will be open as above.

10 a.m.—General meeting of members at the Adelphi Hotel. A selection of Papers will be presented in abstract and discussed as time permits.

10 a.m.—Ladies not attending the general meeting will meet at the Adelphi Hotel, leaving for visits to (*a*) Messrs. Bryant & May's match factory or (*b*) Messrs. Johnson Bros., dyers, Bootle.

2.30 p.m.—Members and their ladies will assemble at the Pier Head and embark on a ferry boat, when, by kind invitation of the Wallasey Corporation Ferries Committee, a sail on the River Mersey will be made. This will provide an opportunity of viewing the docks, engineering works, etc., on the banks of the river. The ferry boat placed at the disposal of the members is one of the new boats recently introduced, and is fitted with the Flettner rudder. Afternoon tea will be served on board and the party will return to the city about 5 o'clock.

8.30 p.m.—Members and their ladies will assemble at the Town Hall for a reception by kind invitation of the Lord Mayor of Liverpool, Miss Margaret Beavan, at which they will meet the members of the Associated Learned Societies of Liverpool and District. Dancing. (Evening dress and decorations.)

FRIDAY, SEPTEMBER 7.

9.45 a.m.—Trip to Bettws-y-Coed and Dolgarrog. Those members and their ladies taking part in the trip into Wales will assemble at the Pier Head at 9.45 a.m., and cross the river by the Birkenhead ferry boat leaving at 9.50 a.m. From Woodside, Birkenhead, the party will proceed by char-a-bancs through rural Wirral, Queensferry, Mold, Denbigh, to Bettws-y-Coed, where lunch will be provided at 1 p.m. After lunch the party will be divided into two sections, those wishing to visit the works of the Aluminium Corporation will proceed to Dolgarrog, arriving at 2.30 p.m. One hour will be spent in the works, and the party will leave at 3.30 p.m. for Colwyn Bay, arriving at 4.30 p.m. Ladies and others not wishing to visit the works will leave Bettws-y-Coed at 2.30 p.m. to visit the Swallow Falls and proceed thence to Colwyn Bay, meeting there the rest of the party. Members and their ladies desiring to return to London or Birmingham on Friday evening should travel from Colwyn Bay by train. Tea will be provided at Colwyn Bay and the return journey commenced at 5.30 p.m., Birkenhead being reached at 8.30 p.m. Arrangements may be made for return to Chester instead of Birkenhead if intimation is given. Tickets for this trip (exclusive of any train fare from Colwyn Bay) will be issued at 17s. 6d., including lunch and tea. Remittances should accompany applications for tickets and be made payable to Mr. B. Heathcote, Hon. Treasurer.

General Information.

Booklets giving details of the city of Liverpool will be provided by the Local Reception Committee. Badges will be worn.

Hotel Accommodation.—Members who require hotel accommodation and who have not already made reservations are strongly advised to do so without delay. The official headquarters of the Institute will be at the Adelphi Hotel, where, for the convenience of members, a large block of rooms has been provisionally engaged. The meetings and other functions on September 5 and 6 will be held in this hotel. Other hotels include the North-Western Hotel (Lime Street Station) and the Exchange Station Hotel. Members applying for rooms at any of the hotels should emphasise the fact that they are applying for accommodation in connection with the Liverpool meeting and as members of the Institute of Metals.

Railway Vouchers.—Railway vouchers entitling members and their friends to obtain return tickets from any British station to Liverpool and back at the specially reduced rate of a fare and a third are obtainable on application to the Secretary. One such voucher is enclosed herewith (in the case of British members). The railway companies have granted these reduced fare facilities in return for a guarantee which has been given by the Institute for a minimum number of passengers. Members and their ladies are particularly requested, in the interests of the Institute and themselves, to avail themselves of this concession, instead of making other railway arrangements. By so doing they will help to increase the number of vouchers issued and so fulfil the guarantee. Members who live a short distance from Liverpool are also requested to avail themselves of these vouchers (using several, possibly, daily) in preference to making other railway arrangements. Should the guaranteed number of passengers not be reached, it is possible that the railway companies may decline to grant these privileges in future years.

Papers to be Read.

The following communications are expected to be submitted:—

"Laboratory Experiments on High Temperature Resistance Alloys," by C. J. SMITHELLS, D.Sc., S. V. WILLIAMS, B.Sc., and J. E. AVERY, B.Sc.

"Corrosion at Discontinuities in Metallic Protective Coatings," by U. R. EVANS, M.A.

"The Constitution of the Alloys of Aluminium with Copper, Silicon and Iron," by A. G. C. GWYER, B.Sc., Ph.D., H. W. L. PHILLIPS, B.A., and L. MANN.

"The Copper-Magnesium Alloys." Part III, by W. R. D. JONES, M.Sc.

"Note on Practical Pyrometry," by G. B. BROOK, F.I.C., and H. J. SIMCOX, B.Sc.

"Eighth Report of the Corrosion Research Committee. The Corrosion of Condenser Tubes. 'Impingement Attack,' its Cause and Some Methods of Prevention," by R. MAY, A.R.S.M.

"The Rockwell Hardness Test," by J. E. MALAM.

"Die-Casting Alloys of Low Melting Point," by T. F. RUSSELL, Assoc. Met.; W. E. GOODRICH, B.Met.; W. CROSS, B.Sc.; and (in part) N. P. ALLEN, M.Met.

"Work-Softening of Eutectic Alloys," by F. HARGREAVES, A.R.S.M.

"Die-Casting of Copper-Rich Alloys," by R. GENDERS, M.B.E., M.Met.; R. C. READER, Ph.D.; and V. T. S. FOSTER, M.Met.

"The Alpha Phase Boundary of the Copper-Silicon System," by C. S. SMITH, D.Sc.

"Properties and Production of Aluminium Die-Castings," by S. L. ARCHBUTT, J. D. GROGAN, B.A., and J. W. JENKIN, Ph.D.

"Methods for Investigating Alloys of Reactive Metals," by W. HUME-ROTHERY, Ph.D.

"The Strength of a Cadmium-Zinc and of a Tin-Lead Alloy Solder," by C. H. M. JENKINS, B.Sc.

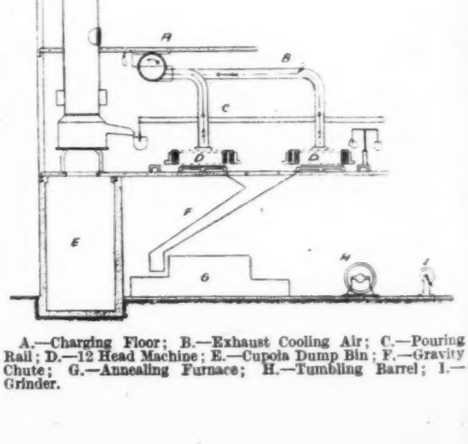
"Note on the Treatment of Aluminium and Aluminium Alloys with Chlorine," by D. R. TULLIS.

New Members and the Liverpool Meeting.

Only members, student members and applicants for membership (with their ladies) will be entitled to participate in the Liverpool meeting (except that visitors may attend the reading of Papers). For the convenience of applicants for membership who are desirous of attending the meeting a special election is being arranged in connection with which membership application forms should be received by the Secretary not later than noon on Friday, August 31, 1928.

The Holley Process Lay-out.

This is the latest lay-out for the Holley Permanent Mould Process, which now apparently includes an annealing treatment.



A.—Charging Floor; B.—Exhaust Cooling Air; C.—Pouring Rail; D.—12 Head Machine; E.—Cupola Dump Bin; F.—Gravity Chute; G.—Annealing Furnace; H.—Tumbling Barrel; I.—Grinder.

A Good Clean Casting.

BY W. J. HISCOX.

When a foundry attracts customers and then fails to hold them there is obviously something wrong, either with the price, delivery, quality or appearance of the product. In regard to the price, it may be contended that this would be known to the customer before he placed his order, and cannot therefore be considered as an obstacle to further business, but the quotation was probably on a weight basis, and the castings produced were much heavier than the customer had been led to expect.

So in this instance appearance, as well as price, is a retarding factor, and it is really surprising how many foundries believe in producing the substantial casting. They know that the customer does not want superfluous weight, but he has to have it, and pay for it, too. Then surprise is expressed because he does not place another order.

But apart from the question of weight (and incidentally, price), the question of appearance generally does not receive sufficient attention in many foundries, and this is the reason why a good many orders are lost. The castings produced may be quite good, but they are rough, and this is regarded as a fatal blemish by many customers. When the first order is executed, the "finish" of the castings is everything that can be desired, which shows that the foundry recognises the value of a good finish. On the strength of this the customer is impelled to place a second order, but in connection with this the resultant castings are not nearly so pleasing in appearance, while the appearance of the castings despatched against the third order is such that the customer declines to place further orders with that foundry.

It is not so much deliberate intent as carelessness which causes the finish to deteriorate. With the first order there is a desire on the part of the foundry to impress the customer favourably, and special attention is given to the appearance of the castings, but with a "repeat" order the desire to impress is not so pronounced, hence a certain amount of laxity in the execution of the order. This is, however, a fatal mistake; it would be much better to let the customer have castings of "normal finish" in the first instance, and not lead him to expect more than he is likely to get. He might have been satisfied with these, in which case his custom would have been retained, but no customer will tolerate the gradual falling away from the standard set up in the first instance.

Fettling Shop on Production Basis.

It need cost the foundry but very little more to turn out well-finished castings in place of those of an indifferent finish, if the fettling shop is regarded as a production department, and not as an expense department. In very many foundries, however, the latter view is taken, and every effort is made to restrict expenditure in the fettling shop. Yet it is surely realised that the casting is useless for commercial purposes until it has received attention at the hands of the fettler—the man who transforms the crude object into a saleable commodity. His work on any one casting may be little or it may be much, but it is most certainly necessary, and production cannot be said to be completed until this work has been done.

The moulding shop is equipped with up-to-date appliances, and the work is sectionised and planned to ensure economical production, but the advantages gained in this connection are sadly impaired by the backward state of the fettling shop. In some foundries, of course, the fettling shop gets its fair share of attention, but it is too often the case that the work of this section is regarded as insignificant, and its equipment compares most unfavourably with that of the other sections.

It is of little use organising to produce without organising to sell, for obviously the foundry produces so that it can sell. But the casting, lying in the foundry, is valueless commercially, while from the foundry standpoint it is an expense, because money has been spent on it. When, however, it has passed through the fettling shop it becomes valuable, because it has been transformed into a saleable product.

Is it not worth while using the product to induce further sales by rendering its appearance pleasing? "A good, clean casting" is an excellent recommendation, and notice is always taken of it. The fact that clean castings of a somewhat indifferent quality command a market shows how much appearance really counts. Of course, the inferior casting will ultimately get its just deserts, for not even appearance can save it, but it is easy to see that the good, clean casting will command more sales than the good, rough casting, because the appearance of the latter is repelling, and its good points are lost sight of.

The inference is obvious—produce a good casting and sell a clean casting. Promote the fettling shop to the same status as the moulding shop, and the saleable product will be a credit to the foundry. The customer will be pleased with it, and will order more; prospective customers will be attracted by it, and will place a trial order. On the other hand, if the casting is good but rough, its goodness will never become apparent to many, because they are deterred from buying on account of its appearance.

There is no need for a casting to look pretty, but it must look smart. It must challenge comparison, and then it will sell. There need be no superfluous handling or "finnicking about" with the finish, but neither must there be any careless "Oh, it's good enough." It must be such that the foundry can take a legitimate pride in its appearance and feel that it is worthy of the producer.

Machinability.

A good bit has been said of late about machinability, and naturally this is of the utmost importance to the user of the casting. But the other factors which go to make the good casting must not be overlooked, and it is the writers contention that many castings which are quite good from a machining standpoint are rejected because of their unprepossessing appearance. Another matter which has to be considered is that nowadays castings with their sides unmachined are placed in jigs for drilling operations, etc., and if there are "blobs" or rough patches on the outside, they have to be removed before the casting can be placed in the jig. And this means time—and money.

It is worth while a foundry being jealous of its reputation of being a supplier of good, clean castings, and doing all in its power to maintain this reputation. But once the desired standard has been reached, there must be no going back. The saying that "Familiarity breeds contempt" does not apply to business, although there are many business firms who appear to think that an old customer does not require so much attention as a new one. But this is wrong; the old customer does not like to think that his custom is regarded as a foregone conclusion, and when he feels that his supplier is taking advantage of an old association, he takes his custom elsewhere.

British Industries Fair.

Less than 10,000 sq. ft. of stand space now remains to be allocated for the Heavy Section of the British Industries Fair, to be held in Birmingham, February 18 to March 1 next. To have reached such a position more than six months before the opening would in itself constitute a very remarkable record, but it becomes a mark of phenomenal success when three important factors are taken into account:—Many firms have already been "rationed" to the dimensions of stand space which the Birmingham Fair authorities consider they can use to the best economic advantage.

The space-lettings to date include a large area allocated in anticipation of extensions yet to be carried out for 1929.

For three years in succession the Birmingham Chamber of Commerce (Inc.) have made provision for immediate and, as it was believed, future needs by permanent extensions at a total constructional cost running into six figures. The great extension for the 1928 display of heavy goods and hardware brought the Fair in Birmingham up to an immense area of 400,000 sq. ft. available for exhibition purposes—all on one floor and under one continuous roof, making it easily the largest exhibition hall in the country.

Random Shots.

Well, Marksman is glad to say that on the occasion of his first birthday "Random Shots" is a flourishing infant of the greatest promise. In order to leave no stone unturned and to omit nothing which might contribute to the said infant's success in life, we have already entered him for Eton, Harrow, Rugby, and several lesser lights among our national educational establishments, and to cover still further possibilities, his name is down for several of the leading colleges both at Oxford and Cambridge. Indeed, plans are already in preparation for the celebration of his coming-of-age . . . . you know the sort of thing . . . . "Among the interesting young men who will attain their majority this year is Mr. R. Shotts . . . ." (They'd be sure to add that extra "T," I'm afraid.) Though, to tell you the truth, Marksman would rather the young rip went into the works and learnt his job before he was old enough to have too many notions in his head. . . .

* * *

I am aware that a number of people in this country possess very fine specimens of artistic ironwork of Russian origin, but I have never heard of cast-iron chessmen until the other day. I read of them quite casually in a newspaper correspondence whose opening I missed. Apparently there formerly existed a factory at Kazlee, in the Ural Mountains, that made various kinds of artistic ironwork, and rather specialised in these chessmen. The writer went on to say that he had a complete set of them in his possession. . . . Surely they would be a supreme test of the founder's craft!

* * *

A few weeks ago I was discussing the serious way in which hotel-keeping and its kindred arts are studied on the Continent as compared with our shipshod English methods. I have now the satisfaction of being able to add that the Continental model has been adopted in America—with embellishments! The following passage, gleaned from an American journal, tells its own tale:—"The first class of college-trained hotel men was graduated from Cornell recently. Everything from potato peeling to the assignment of the bridal suite was included in the curriculum. Diplomas of the graduates vouched for the ability of the college-bred hotel man to cut and roast a steer, to make beds, to hop bells, to arrangements for a business man's club luncheon or an epicure's banquet, etc."

* * *

And while on the subject of the Higher Education in America, what about this soul-stirring appeal from the advertisement columns:—"Become Bachelor of Physical Culture or Master of Weight Lifting. Wonderful field. Peoples College, Kansas City."

* * *

The story that follows is by way of being a solemn warning to all husbands who are—shall we say—spasmodic in their affections. Jones complained to a friend that he really didn't know what was the matter with the wife lately. The friend, who knew Jones rather well, inquired discreetly how he treated the lady. "D'you ever take her out, old man? Give her presents? All that sort of thing? . . . ." Jones admitted that he did not. "Well, now, old fellow, you take my advice. . . ." When Jones went home he staggered beneath a 2 lb. box of chocolates, a large bunch of flowers, a pair of silk stockings, and two theatre tickets. He stepped proudly over the threshold, and began:—"Well, my dear—" and stopped, for his wife had burst into tears. "If that isn't too much," she sobbed, "first the boiler bursts, and then cook gives notice, and then *you* come home *drunk!*"

* * *

More Shakespeare in the Foundry.

The Foundry Manager: Rumours most strange
have lately reached my ears
Laments I would not call them. Can'st thou
tell
What meaneth this?
The Foreman: My mind, most virtuous sir,
Harbours no least suspicion of the root
Of this most grevous thing.

* * *

MARKSMAN.

Wet Process Vitreous Porcelain Enamelling No. 5.

COMMON GROUND COAT FAULTS AND THEIR ELIMINATION.

By W. Marshall.

The following is a list of common sheet-iron ground coat faults, with suggested methods for both their elimination and avoidance.

Use of Raw Feldspar or Quartz in the Ground Coat.—The writer suggests the use of a small quantity, say 3 per cent., in the ground coat, that is in the milling operation, for the reason that an enamel containing feldspar will hold up much better on the edges, and not burn off as quickly in the light portions of the dipping. Quartz can be used for this purpose, but it tends to increase the brittleness of the enamel.

Chemical for Setting up Enamel.—The use of borax or other chemicals for setting up enamel should be discouraged except for a fixed amount which is put in the raw batch when milled, that is, 0.25 per cent. This is sufficient to make enamel dip evenly and smoothly, and if the water contents are properly weighed it will require no additional attention preparatory to the dipping operation.

Clay Content.—A maximum of 6 to 8 per cent. of clay should be the limit of clay used in ground coat for dipping stove work or ice-box linings, as the clay content has a tendency to increase the hardness of the enamel and demands greater burning time.

Water.—No place is known where water has been proved a direct cause of ground coat troubles, that is, where city water is used. If, however, the water is high in alkalis, the trouble usually occurs in the pickling operation, and not from the water contents in the enamel. This can be eliminated by using stronger acids in the pickling. However, the water must be clean, and if it contains iron it will do no harm in the ground coat, but will cause brown spots in the finished ware.

Spraying of Ground Coat.—Ground coat can be sprayed, but it is not common practice, due primarily to the difficulty in spraying pieces evenly; but considerable experimental work is going on at present to control this mechanically, and if the ground coat can be sprayed evenly it will no doubt be the most economical way to handle it. Where a piece is unevenly sprayed the result will be that part of the piece will be satisfactory whilst the rest will be spoiled by pimples.

Ground Coat Faults Explained.

Pimples or Copper Heads.—The commonest cause of pimples or copper heads is dipping too thin or overburning. This can be readily determined as portions of the piece will be overburned and can be corrected by redipping and reburning. However, should one attempt to apply a finish-white over a pimple or copper head ground coat it will be found impossible to save this piece, but the fault can be corrected by redipping in the ground coat. The pimple or copper head will also appear if the piece is not properly neutralised after the acid bath. Another cause for this is faulty iron, which is rare to-day, especially with the use of ingot iron.

Fish Scale.—No explanation is necessary to anyone who has been in the enamelling industry for any length of time as to what fish scale is, and many gallons of printer's ink have been wasted on the explanation of fish scale with no definite conclusion, but fish scale has a definite cause, as is the case with any enamel fault, and can be found and corrected. Possibly the most common causes of fish scale are as follows:—

Milling too fine.—Mere observation of the dipping enamel before burning will discover this.

Too heavy dipping.—This is indicated by the burnt piece not having the proper colour. If dipping is controlled closely, trouble of this kind can be corrected before pieces are burned. The method of testing the dipping has been already explained.

Use of improper clays.—Only tried and tested clays for suspending agents should be used.

Use of improper iron.—Experience has proved that it is poor economy to purchase iron unless it is specially made for enamelling purposes, and is free from impurities.

Overburning.—The fish scale produced from overburning is very fine, that is, in most cases it is hardly perceptible to the eye, but one can discover it by running the palm of the hand over the finished article and holding it to the light. The correction in this case is cutting down the burning time, and redipping the overburnt article.

Underburning.—This fish scale is of the larger variety, and may be very readily classified by the colour of the burnt sheet. If the ground-coat sheet has a lighter blue than ordinary it is underburned. The correction of underburning will eliminate this.

Improper neutralising.—Where acid strengths of 6 to 8 per cent. are used in pickling with hot acids the steel has expanded and must be treated in a hot bath in order to neutralise all of the acid.

Use of setting up chemicals.—If too much borax, Epsom salts, soda or ammonium carbonate is used to thicken the enamel this will result in fish scale, and must be one of the things to consider when fish scale is being sought for.

Strong neutraliser.—If the neutraliser solution is too strong, that is, too much alkali used, a deposit will be carried on the ware and have a tendency to set up the dipping enamel so that water will have to be added constantly. If continued for any period this will result in fish scale trouble. The safest practice is to use weaker neutralising solution but neutralise for a longer period—from four to five minutes.

Note:—The lower-burning enamels are more apt to fish scale than the high-burning enamels, consequently they must be more fool-proof and no operator should attempt to use enamels in practice that have not been thoroughly tested before a large quantity of work is put through. Ground-coat enamels should be manufactured under technical supervision, and the various chemicals should be analysed, blended and smelted in smelters with pyrometer control. Enamels should be thoroughly tested in shop practice before large quantities of work are dipped and burned in the ground coat.

If this practice is followed, enamel as a cause of ground-coat trouble can be eliminated. In the manufacture of "ferro-enamels" this practice is followed, and no enamel is shipped without being thoroughly tested. In conclusion, ware which is properly handled in the ground-coat process should produce a finished surface free from lumps and burnt to a blue-black colour with a semi-gloss lustre.

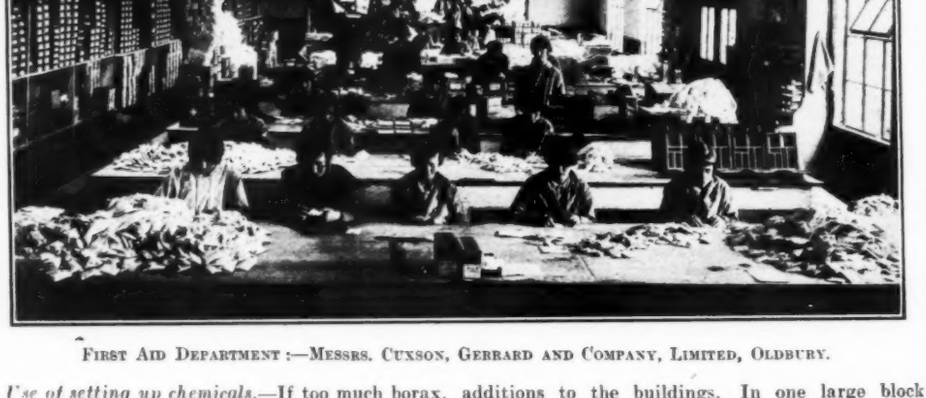
Mr. W. H. Shephard, managing director and chief proprietor of W. H. Shephard, Limited, Trent Street Works, Sheffield, died this week at his residence, Sitwell Vale, Rotherham.

A Factory for "First Aid" Appliances.

Numbered among the pioneer firms engaged in the manufacture of first-aid equipment, Messrs. Cuxson, Gerrard & Company, Limited, of Oldbury, have now been producing their fine quality goods for about forty years. The business was established practically half a century ago by Mr. John Cuxson and the late Mr. A. W. Gerrard.

Many years' experience as pharmacist at the Great Northern, Guy's and University College Hospital, London, equipped Mr. Gerrard with a wide knowledge of the requirements of hospitals in the way of surgical dressings, surgical and medical plasters and ligatures.

To-day an extensive factory is in being at Fountain Lane, Oldbury, near Birmingham, from which supplies are sent to hospitals, institutions, chemists and Government departments throughout the world. The rapid development of the business during recent years has necessitated frequent additions to the buildings. In one large block in the works the manufacture of surgical dressings is a prominent feature; boric lint, gauzes, wools and bandages being made, handled, rolled and packed by a small army of well-dressed and uniformed female workers, under strictly hygienic conditions.



First Aid Department:—Messrs. Cuxson, Gerrard and Company, Limited, Oldbury.

Twenty years ago the late Mr. Gerrard foresaw the trend of industrial welfare in providing for adequate and suitable materials to be made for dealing with minor accidents in large works by means of first-aid dressings and equipment. In this connection he submitted many original suggestions to the particular Government department concerned, and eventually regulations were issued relating to the provision of first-aid equipment for factory use. Even to-day several of Mr. Gerrard's original ideas are embodied in the first-aid dressings in regular use.

First-aid cases, mines regulation cases, stretchers, tourniquets, dust respirators—in fact, all first-aid equipment—are made and assembled in a long, well-lighted department, solely devoted to these manufactures, which we illustrate in Fig. 1.

Thermal Expansion of Stainless Iron.—The U.S. Bureau of Standards recently completed an investigation on the thermal expansion of low-carbon iron-chromium alloys of the "stainless iron" type. No data on this subject were available. These alloys are being used to an increasing extent for various purposes, such as parts of steam turbines, devices for handling acids, and in the manufacture of other articles that must resist corrosion. A scientific Paper which gives results on the expansion of stainless iron for various temperature ranges between room temperature and 1,000 deg. C. is now in the press. Critical regions were located on some samples of stainless iron. This material expands about 17 per cent. less than pure iron for the temperature range from room temperature to 100 deg. C.

British Facilities for Foundry Training.

No. V.—LOUGHBOROUGH COLLEGE, LEICESTERSHIRE.

By Percy Fox-Allin, Associate Editor of "The Foundry Trade Journal."

Loughborough College is probably the only institution in the kingdom in which it would be possible to impart to the foundry student a highly scientific training combined with a thoroughly practical experience. Unfortunately, for the time being, there is no special course set apart for purely foundry practice. At the same time a considerable amount of care is taken with the training of foundry apprentices in the evenings during the winter session. In this course apprentices are given theoretical and practical training in the elements of foundry work, and such subjects as sketching and drawing and simple calculations are included. These classes in elementary foundry work are thoroughly practical, and care is taken to see that they do not become too technical from the academic point of view.

From time to time the college is also attended by a few day foundry students, who attend particularly for the more advanced foundry work and metallurgy.

It will be obvious from the appended description of the equipment that apprentices from small foundries have the opportunity of trying out moulding machines and other plant which they have not the chance of seeing in their own foundries.

Loughborough College is an excellent example of good resulting from an evil, for its inception was entirely due to war-time requirements.

Prior to 1914 the Loughborough establishment was nothing more than an evening school. In December of the year named, with the aid of the Government, the establishment was taken over by the present principal, Dr. H. Schofield, Ph.D. (Lond.), B.Sc. Hons. (Lond.), A.R.C.Sc. (Lond.), Assoc.M.Inst.C.E., M.I.Mech.E., D.I.C., F.Inst.P., and under his direction a large number of shells were manufactured. It was, however, in the training of munition workers that the Loughborough institution became of national importance. The intensive nature of the work may be gathered from the fact that on one occasion during 1916 four hundred women were trained for the works of Cammell Laird in ten weeks.

At the close of hostilities the institution had still some hundreds of ex-soldier munition workers in its charge. But there was available an engineering works upon which the Government had spent a quarter-of-a-million pounds, and a highly-trained instructional staff; no time was thus lost in training the ex-service men as fitters, turners or machine operatives, and thus to fit them for civil life. In the meantime the institution had thrown open its doors to the ordinary fee-paying student. So that in 1919 there were three types of pupils: Ex-soldiers, ex-officers, these last taking courses in civil and mechanical engineering, etc.—for degrees and diploma courses, etc.—and the diploma students, which last are now the sole occupants of the College.

Loughborough College to-day is certainly the most virile training institution in the kingdom, possibly in the world. The equipment of the College is that of a very up-to-date self-contained engineering works, with a variety of machine tools and auxiliaries which would usually only be found in our largest works; whilst the staff, needless to say, is composed of men whose scientific attainments have been proved in practice.

The works are comprised of foundry, pattern-shop, general machine shop, heavy lathe shop, automatic machine shop, precision grinding shop, tool room, heat-treatment laboratory, smiths' shop, milling machine shop, electric fitting and erection shop, oxy and electric welding shop, gauge and instrument making shop, fitting and erecting shops, drawing office, etc. Space at our disposal will not permit of a lengthy description of the various shops and their equipment, further, it is with the foundry portion of the works which we are mainly concerned.

Foundry Equipment Available.

The foundry is completely equipped in every respect for the manufacture of all types of castings, large or small; the depth of sand varying from one to five feet in order that pit work may be undertaken.

The equipment consists of a 5-ton "Whiting" cupola, complete with charging platform; a 1-ton "Whiting" tilting cupola; 300-lb. "Morgan" gas-fired tilting crucible furnace; high-pressure air-blast steel furnace; gas-fired "Wright" pit-type aluminium furnace; two "Carr" crucible furnaces for brass; melting pot for low-temperature alloys; two annealing furnaces for heat-treatment of castings and steel; and malleable-iron oven. The moulding machines available include "Ajax" jolt-ram machine with rapping, turnover and drawing attachments; "Mumford" jolt-ram machine; "Farwell" machine; "Adaptable" and "Pridmore" machines. Included in the auxiliaries are oscillating sand-sifting machine; "Alfred Herbert" sand-mixing machine; "Jackman" magnetic separator; tumbling barrel; sand mill; twin "Norton" grinder, etc.

An "Ingersoll-Rand" compressor with air receiver supplies pressure air through mains which extend completely round the foundry for the service of pneumatic tools.

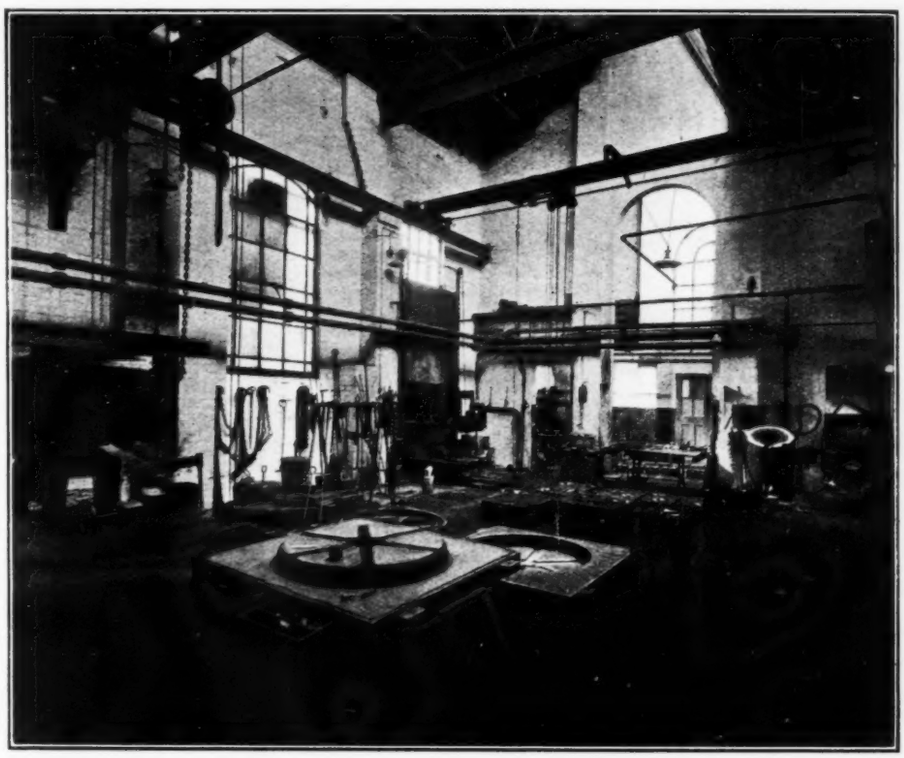


Fig. 1.—Moulding Floor, showing the Core Stove and Tilting Crucible Furnace. The Loughborough Technical College.

Pattern Shop.

The pattern-shop equipment is equally comprehensive; naturally a works of this nature could not maintain the plant purely on pattern-making account, the shop thus serves also as saw mill, cabinet and general woodwork shop. The machines comprise "Wadkin" universal mechanical woodworker, with attachments for regular and irregular patterns and core boxes, gear cutting, grooving and trenching, square morticing and tenoning, dovetailing, panel raising and taper slotting; a 30-in. circular saw with rising table; a 24-in. pendulum cross-cut circular saw; a 16-in. double dimension circular saw with canting table; a 7-in. jig saw with canting table; a 20-in. combined surface planer and thicknesser, with safety circular cutter block; a 15-in. panel planer and thicknesser; a 9-in. thicknesser; a 7-in. lightning planer; a 4-in. portable bench surface planer; a 6-in lathe with travelling rack slide rest and extending spindle for turning up to 6 ft. in dia.; both 6-in. and 7-in. lathes with gap beds; a "Shawyer" spiral turning lathe; 22-in. disc and 10-in. vertical reciprocating bobbin; a sander with canting tables; a vertical spindle moulder with reversible countershaft; micrometer and eccentric fences; a 10-in. by 1½-in. vertical borer; a hand-morticing machine; several bench and capstan trimmers, saw sharpeners, saw setters, etc. The saw mill and shops are provided with a dust-extractor plant by which all wood refuse is conveyed to a central-heating chamber. A sprinkler system is also installed throughout to reduce the possibility of serious fire.

The drawing office has been designed on modern lines as regards lighting and accommodation. A glazed cupboard runs the whole length of the office and contains examples of machine parts of all kinds and a large demonstration blackboard with balanced sliding T-square is fitted at the front end.

A commodious printing room is arranged as an annexe, and contains an electric copier, developing sink, dark room for paper storage, etc. There is also ample accommodation for the storage of drawings and tracings.

Brief mention only need be made of the machine shops. The general machine shop is equipped with about twenty centre lathes, with swings of from 6 in. to 36 in., comprising machines by all the leading British and American manufacturers; also shaping machines and capstan lathes. The automatic machine shop contains examples of all types of semi-automatic and full automatic lathes for bar and chuck work. The precision, fitting,

tool- and gauge-making shop is equipped with machines and appliances for the manufacture of precision instruments of all types of flat, screw and plug gauges. The heavy lathe shop is equipped with centre lathes ranging from 5½-in. to 21-in. centres, which are representative British and American tools. The grinding-shop equipment includes plain, universal and surface grinders of various capacities to deal with the work from the different machine shops. The milling-machine shop contains examples of most of the well-known makes of both plain and universal milling machines, illustrating vertical as well as horizontal types.

From the foregoing it will be understood that the foundry and pattern-shop come under the engineering section. The student whose course extends over a period of five years first spends at least two terms in the foundry, to be followed in order by a course in the pattern-shop, drawing office, and the various machine shops.

As already stated, for the time being, no special course has been laid down for the benefit of the foundry student, though the foundry is not only equipped for practical work, but is actually engaged on useful production; this last is a very valuable feature, as it tends to foster interest, the student feels that he is responsible for the production of something of moment. We suggest, too, that the system of instruction approaches very nearly to the ideal.

During his course at the College the student spends alternate weeks in the works, full factory time being kept, the student thus acquires, as he could do in no other manner, that knowledge of factory atmosphere which sooner or later must be acquired when he is absorbed by industry. Alternate weeks are devoted to a study of the scientific side of the work, so that the student receives both theoretical and practical training concurrently; his work at the College being made to keep step with his progress in the works.

A system of education upon these lines would appear far preferable to a lengthy period in the works, interleaved with a continuous period in the College; experience has shown that a student will evidence a more real appreciation of theory when he sees how it works out in practice.

The facilities are available, and the system of instruction at Loughborough College would meet every requirement for the theoretical and practical training of the foundry apprentice; assuming a course of study could be set apart for such student. Obviously the present function of the College is the making of a theoretical and practical production engineer; that, of course, is going beyond our requirements, and, we are afraid, also beyond the means of the average embryo foundryman.

It is possible that Dr. Schofield might consider a scheme to cover the scientific and practical training of the foundry student, though it would no doubt be necessary to satisfy him that the measure of support extended would justify the innovation.

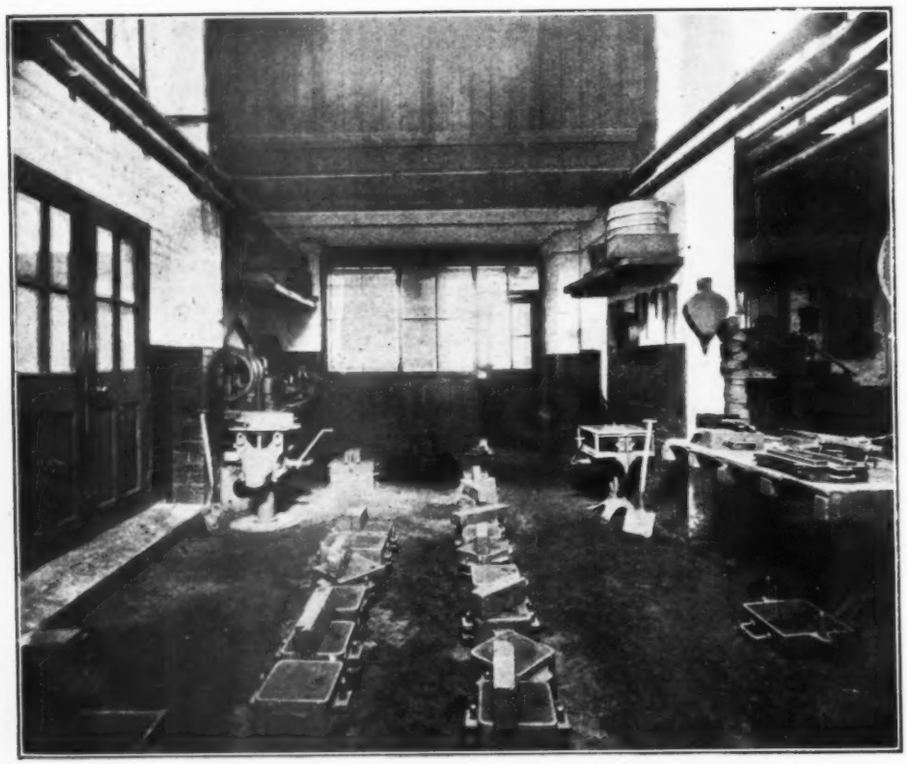


Fig. 2.—The Non-Ferrous Moulding Shop. The Loughborough Technical College.

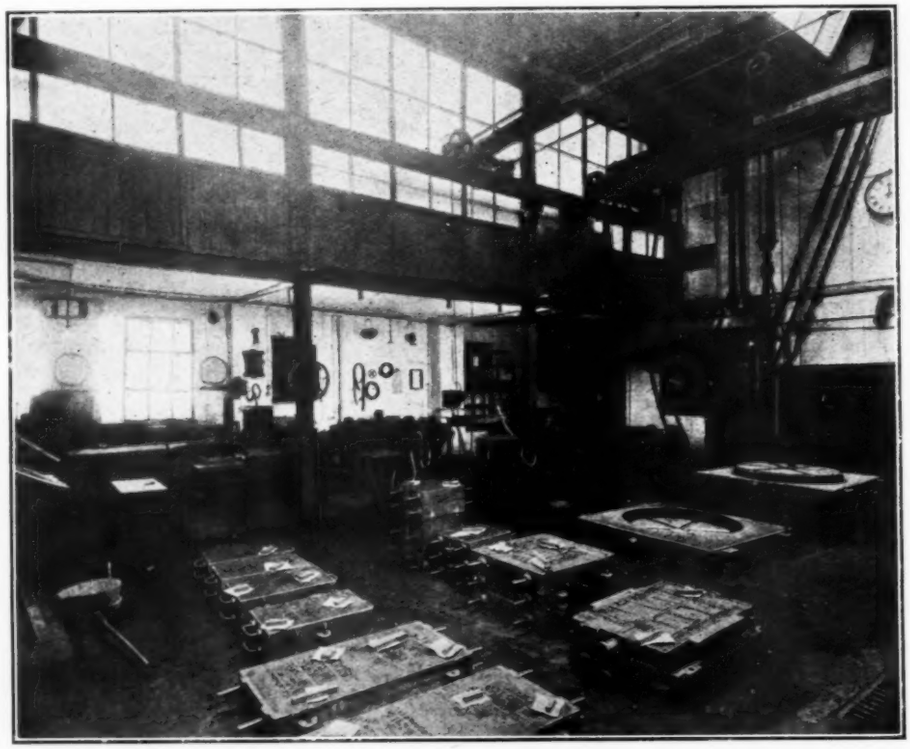


Fig. 3.—The Machine Moulding Bay. The Loughborough Technical College.

Nottingham's Prospects.

Although there is still unemployment among foundry workers in Nottingham, hopes are entertained for some improvement soon. At the firm of Messrs. Cammell Laird & Company, Limited, one of the largest firms in the city, business has not been so brisk, but news is now to hand that a portion of a large contract which has been placed in this country will be carried out at these works. It will find employment, and also may mean a number of men who have been on short time working full hours.

A Stanton Appointment.

Mr. J. N. Derbyshire, senior partner in the firm of Messrs. Derbyshire & Company, of Nottingham, has been made a Justice of the Peace for the City of Nottingham. Mr. Derbyshire is chairman of the management committee of the Stanton Ironworks Company, Limited, and also chairman of the Gotham Company, Limited. He is a very active man, and among many offices which he holds outside the trade is that of President of the Notts. Chess Association. For three years during the war Mr. Derbyshire served in an honorary capacity at the Ministry of Munitions as director of contracts and liquidator of the Department.

Mr. Herbert Warner, the founder of the Middlesbrough firm of Messrs. Warner & Company, Limited, has died in London at the age of 76.

Design and Shrinkage.

By F. C. Edwards.

Castings first exist as self-formed, liquid bodies. Their temperature at this stage, in the case, say, of aluminium, would be about 700 deg. C., and for iron about 1,400 deg. C. In cooling (by direct conduction and by radiation), they progressively assume a solid condition. Simultaneously, they shrink. The dual transformation occurs, of course, whilst the casting is confined to its mould. This naturally involves some degree of constraint; the mould is more or less resistant to the shrinkage of the casting. Such constraint, it should be remembered, acts upon the casting when it is least able to withstand it—namely, its semi-solid stage. Through its agency, indeed, many a projecting limb has been wrenched off the body of a casting because the moulder had neglected to leave a sufficient thickness of sand (as a compressible cushion) between the limb and some interfering bar of the moulding box, or, alternatively, because the cope had been left a moment too long on the job after it was cast. A typical example of this, which may be of interest in passing, is illustrated in Fig. 1.

Assuming that the nearest available cope allowed but ½ in. of sand between the box-bars and the pattern at A and B. (Incidentally, the large radius at B might lead the moulder to think there was more clearance here than was actually the case.) Now, with A and B, say, 7 ft. apart, the shrinkage of the casting between them would amount, in grey iron, to ¾ in. And if both ends had identical bearing surfaces, this shrinkage would entail a reduction of the mould at each end of from ⅜ in. to ⅛ in. But the heavy end, B, is seen to have a considerably wider surface contact with the box-bar than that at A. It follows that the compressibility of the mould in the former case would be correspondingly reduced. Shrinkage, therefore, may be expected to operate almost exclusively in the direction of the arrow, C—thus leaving no space for the accommodation of the ½ in. of sand between the projection and the box-bar at A! Then, either casting or cope must inevitably succumb before the irresistible force of shrinkage. The odds are against the casting's survival, for it labours under a double handicap. First, it is handicapped by its higher temperature (which means weaker metal), compared with that of the cope; and, secondly, by the greater mass section at the base of the lug (where the greatest leverage is exerted), compared with the body of the job. This greater section—with its relatively slower rate of cooling—implies weaker metal at any given moment during shrinkage. Small wonder, then, that the lug, as shown in the sketch, is "left behind."

Core-Irons in Large Cores.

With large cores, again, unless the core-irons are made to allow for an adequate cushion of sand all round (say, 2 in., at least, for a core 4 ft. long), they may fracture the casting by preventing its shrinkage. Their own expansion, indeed, through the heat of the casting, may serve as a contributory factor in the event. A similar result may be attained—especially in light, aluminium work—by ramming a mould too hard. Contrariwise, cores are sometimes baked to the point of disintegration—in moulder's parlance "rotten"—in order to reduce to a minimum the opposition of the mould to shrinkage.

Even if it were possible to conceive of a casting being made without a mould, however, all but the simple, bar-type would still "evolve" under constraint. The shrinkage taking place in the several members of the casting, at varying angles of incidence and at varying rates, is bound to produce some conflict of forces. Such conflict is waged at the expense of the casting, and militates against its calculated strength. The result, admittedly, may be quite negligible. On the other hand, internal strains may be induced to such an extent as to dissipate most of the reserve strength of the casting provided by the "safety factor." In extreme cases the casting literally falls to pieces under its own shrinkage stresses.

Assigning the Blame.

The usual procedure is to blame the metal, or the moulder, for shrinkage troubles. Well, none can deny that metals, like men, differ in their behaviour under stress. And the skilled foundryman has various correctives at his command for use as occasion requires. His job is to make good castings. To focus attention exclusively on the foundry in such cases, however, is not only grossly unfair to the "Cinderella of Engineering," but often tends to obscure as well as to perpetuate the real source of the mischief. It is treating the symptoms—not the disease: administering purgatives—instead of correcting the diet! Relief is most likely to be forthcoming when sought in the opposite direction—the drafting room—for shrinkage, being an unavoidable concomitant of metals, is inextricably bound up with design.

But here we met with a difficulty. Shrinkage stress is not subject to mathematics. There are no known formulæ to which the young draughtsman can turn for exact figures in order to decide which of several alternative designs will pass least scathed by shrinkage stress into the actual casting. Happily, however, he may use common reasoning, for shrinkage stresses are natural phenomena. As such they never operate without cause. When understood they may generally be anticipated.

The Re-entrant Angle.

Consider, for instance, the operation of shrinkage stress on that notorious *bête noir* of casting design—the re-entrant angle. Fig. 2 represents a grey-iron frame casting, 10 ft. long by 5 ft. wide. This casting would be about 1 in. shorter, and ⅛ in. narrower than its mould. This means that, in cooling down from the liquid to the solid condition, a universal shortening action has been going on. Both ends and sides, in fact (as we might see from the mould before the casting was removed), have moved inwards, as indicated by the arrows D and E. By implication there has been what may be termed a "shrinkage pull" towards the centres of sides and ends respectively. This shrinkage pull is a function of the cumulative cohesiveness of the metal as it passes from the fused to the solid condition. (Incidentally, such cohesive power depends upon the nature of the metal—which is beyond the scope of this article.) With re-entrant angles, as at F, the forces D and E, acting at right angles to each other, would tend to produce rupture, as shown. And the "sharper" the corners the greater—because more concentrated—would be the effect of the differently-directioned forces.

This concentration of stress may be obviated. It is an elementary law of physics that a given stress is more easily carried in proportion as the area is increased over which the stress is distributed. If we increase the "length of the bend" by substituting a curve for a corner, as shown at G, Fig. 2, the forces D and E are rendered less concentrated. Instead of the stress being confined to what almost amounts to a point, as at F, it is spread over the larger radius G.

Bending as a Preventive.

The incidence of rupture not only becomes more indeterminate, but the forces tending to produce rupture are very largely dissipated. A moment's consideration will indicate how this is accomplished. Metal solidifies, of course, from the outside. Regarding bend G, incipient solidification would occur round the edge immediately the job was cast. The rapidly solidifying line of metal round the bend would then assume what may, perhaps, be likened to a "chain formation," each link of which would be loaded with an infinitesimal share of the tension that, in the former case, was concentrated at F. Further, as the interior of the metal at the bend would be in a more or less plastic condition as forces D and E came into operation, each "link" would be able to adjust itself, and thus absorb and nullify some of the tension.

Shrinkage stress may be still more effectively countered by the addition, where practicable, of a continuous "bead" round the edge, as at H. The extra metal supplied by the bead to this part (which is normally the first to freeze) tends to promote a more uniform rate of cooling. By strengthening the line of incipient fracture, it materially strengthens, at a negligible cost of metal, the casting as a whole.

The "double bead"—*i.e.*, one on each side of the plate—as at J, constitutes a superior form of insurance in this direction. Here the advantages of the single bead are more than doubled. Not only does the tension flange gain in effectiveness, on account of its increased width, but, with an identical freezing surface on each side of the plate, the risk of camber, possible, in some circumstances with the single bead, is thus eliminated.

Historic Example.

By reasoning along these lines, we have the key to many so-called mysterious failures of castings. Take, for instance, that historic example, George Stephenson's hydraulic cylinder. It will perhaps be recalled that the cylinder made for raising the "tubes" of the Britannia Bridge had a flat bottom and re-entrant angle—shown at K, Fig. 3. As one of the tubes was being raised, the bottom of the cylinder gave way. Now that failure, which might have been attended by serious consequences, may undoubtedly be ascribed to shrinkage stress—*set up by improper design*. Whilst the casting was passing through its cooling stages, we may assume that shrinkage would occur in the directions indicated by the arrows, L—*i.e.*, both diametral and longitudinal stress would be in operation. We may further assume that the cylindrical shell (being more exposed to cooling influences) would constitute a rigid, incompressible ring before the base had ceased to shrink. Stress would then exist between base and shell, being most intense at the corner—K. Subsequent service pressure (and probably a further drop in temperature) accentuated the stress, with the result as stated.

Although the proper design, as shown in Fig. 4, was adopted for future cylinders, the failure was attributed to the wrong source. It was stated that the casting fractured owing to the formation of planes of weakness similarly as at M. These weak, diagonal planes, it was said, were formed as the crystalline structure of the casting developed, and were the result of the crystals forming at right angles to the cooling surface—as shown at N, N.

This theory stands discredited by actual experience. One meets with distinct fissures in castings at the junction of members under the influence of shrinkage stress. Gaping spaces of ½ in. and over, indeed, sometimes separate parts in which the stress is—or to be more precise, has been (since fracture, of course, releases stress)—particularly severe. Mere planes of weakness cannot account for such spaces; if the crystalline theory were correct, metal, of some kind, would unite the parts.

The hemispherical, or dome, shape—Fig. 4—is the design *par excellence* for pressure cylinder ends. It is analogous to a universal radius, and nullifies shrinkage stress by its self-adjustment. Incidentally, it is the form selected by Nature herself for closing the ends of cylinders—as seen in the ordinary egg. A very serviceable adaptation of this shape is found in the arms of certain well-designed wheels.

Uniformity of Section Desirable.

The golden rule, of course, for obviating shrinkage stress is uniformity of metal section. Differences of mass section between contiguous parts of a casting, indeed, are notoriously prolific of shrinkage-stress fracture. An actual example of this is illustrated in Figs. 5, 6, and 7. The sketches represent a portion of a slide bracket casting. It will be seen that the central body, P, Fig. 5, has a much heavier mass section than the longitudinal lugs, Q. (The heavy section, by the way, was necessary to allow for the machining of deep grooves.)

B

The first casting came out fractured, similarly as indicated at R. Then the moulder had a "brain-wave"—why not reinforce the corners with wrought-iron loops? Accordingly, he placed U-shaped wires in each corner of the mould, as shown at S, Fig. 7. The wires were bent downwards at the open end—as at T, Fig. 6—for the purpose of anchorage. The next casting looked all right—at first. Whilst it was being dressed, however, fractures developed in the same places as before, but were much less pronounced.

Amelioration by Heat Ducts.

Here the design—not the moulder—was at fault. Differential shrinkage was the immediate cause of fracture, and the source of that shrinkage lay in the difference of mass section between the central body of the casting and the lugs. An examination of the first casting (which, luckily, the moulder had kept by him) revealed the significant fact that the end of each strip at the fracture projected longitudinally about $\frac{1}{8}$ in beyond its counterpart on the main body. This proved that the lugs had undergone less ultimate shrinkage than the slower cooling body.

The outer strips would, naturally, freeze first. They would then assume a fixed, unalterable length, whilst the central body, by virtue of its much slower rate of cooling, still possessed the potential power of further diminution. This power, functioning as cooling proceeded, would put the strips in compression. At the bend of the loop, U, shear stress would operate. Finally, through the direct agency of this shear stress, the body of the casting would wrench itself free from its restraining limbs.

Effective treatment, in such cases, lies along the path of synchronising the rate of cooling in the different parts of the casting. Leaving out possible foundry expedients, either the heavier sections should be lightened, the lighter ones strengthened, or their connections well graduated. In the case referred to, connecting bars, V, were added, being subsequently machined out. These bars served as radiators, transferring heat from the body of the casting to the outside strips. In this way, a more uniform rate of cooling was induced throughout the casting.

Test Bar Castings.

It may be argued, of course, that such examples feature extreme cases. Quite true: but they do occur—sometimes; and they are undeniably illuminating: as the visible effect of shrinkage stress in some castings, they suggest its invisible presence in others. Furthermore, the proved antidote in the extreme case should serve as an adaptable prophylactic in design generally. Here lies the gist of the matter. Of what avail is the computed strength of a casting if shrinkage stresses be ignored? Of what use are test-bar data? Indeed, if shrinkage stress is overlooked in some classes of design, the test bar—though meticulously representative of the average thickness of the casting, and made at the same time under identical conditions—may prove but a snare and a delusion.

Hence the vital importance of this subject. It should rank second to none in the curriculum of the budding designer. Its comprehension demands no exhaustive metallurgical knowledge. By examining actual examples of shrinkage fracture, and observing the effect of changes in design (the true scientific method), the student will gradually develop the power of visualising the operation of shrinkage. This leads to the acquisition of what may perhaps be described as "shrinkage sense." Most practical foundrymen have this priceless faculty. Its possessor instinctively feels the presence, in a design, of possible offending features. It enables the draughtsman to select just that design which extracts the maximum efficiency from a minimum weight of metal.

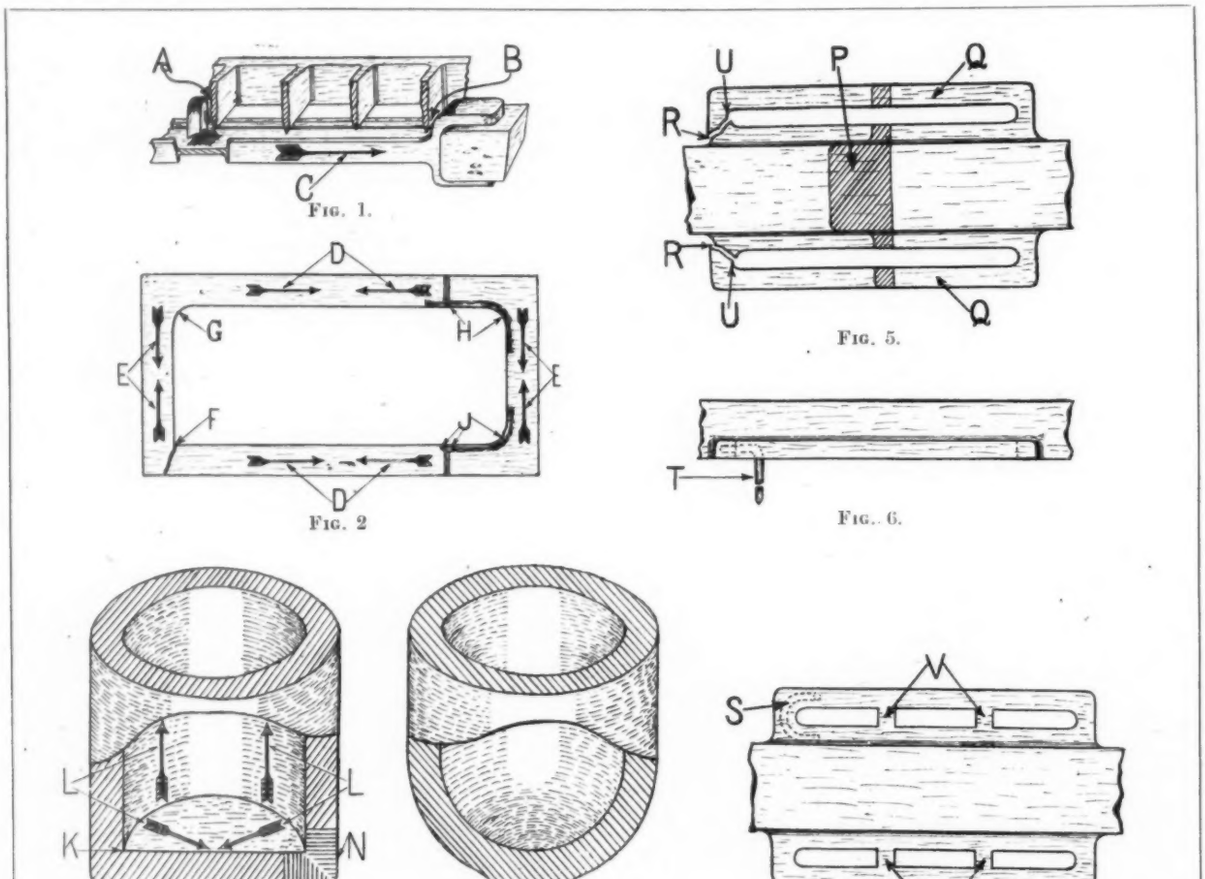


Fig. 1.
Fig. 2
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.

Continental Steel Trust.

Although the output of steel ingots in Germany in the second quarter of the current year shows a slight decline compared with the preceding three months, the German quota in the Continental Steel Trust has again been materially exceeded, namely, by nearly 542,500 tons, as the actual production amounted to 3,703,724 tons, as against an unchanged quota of 3,161,250 tons in the second quarter. As a consequence and on the assumption that the German export share, which was increased to 825,000 tons for the second quarter, has not been exceeded, a penalty of $662,474 will have to be paid for excess output, as compared with $1,162,424 in the first quarter. Of course some part of this sum will be returned to the German industry, as this time all the members of the Trust have exceeded their quotas so that no compensation for short production will have to be paid. For the first quarter the penalty will work out at the rate of 0.60 mk. for the whole production of Germany.

As from July 1 the penalty-rates for excess output have been re-arranged, as already reported. It will be remembered that a penalty of $1 per ton has been fixed for excess output up to 7½ per cent., $2 per ton for the next 2½ per cent., and $4 per ton for further increases over the quotas. The effect of this fresh regulation will, in the first place, depend upon the situation of the market. If the German industry has to export on a larger scale, an increase in the amount of the burden per ton will be more than likely; but the burden would be found less oppressive if an agreement were at last reached within the Trust for the formation of selling syndicates for the various rolled products.

The Schedule Fallacy.

By J. J. Ewens.*

Mechanically the foundries have kept pace with other industries in improving their product and method of manufacture. The use of production equipment and labour-saving devices is widespread. The modern foundry compares favourably with other plants in the use of efficient equipment for economical production. It is in the merchandising of its product, however, that the foundry industry has fallen behind. The weakest spot to-day in the industry as a whole is unintelligent estimating and an obsolete system of pricing or selling castings. The unintelligent estimating is really the result of senseless pricing. If one rectifies the method of pricing one will also improve the standards of quoting.

What is the Sliding Schedule?

The present system of selling castings on a sliding schedule based on weight is unsound in theory, has been a costly practice, and should be abolished. By a sliding schedule based on weight is meant the prevailing method of billing castings according to a set schedule following the rule that the heavier the casting the lower the price. The ordinary schedule is divided into various weight ranges or divisions in this manner:—

Under	1	pound	
Over	1	to 5	lbs.
Over	5	to 10	
Over	10	to 25	
Over	25	to 50	
Over	50	to 100	
Over	100	to 250	
Over	250	to 500	
Over	500	to 1,000	
Over	1,000	to 2,000	
Over	2,000		

A separate price is quoted for each weight range. The price schedules, of course, vary with different foundries, and with different customers, but they all follow the rule of the heavier the casting the cheaper the price per pound.

This vicious system originated with the early foundrymen and has been in almost universal use since. It is only the intense competition of the last few years that has forced the more progressive plants to probe deeper and deeper into costs and pricing policies which has succeeded in bringing about any diversion from the old-established, antiquated method.

The Adoption of the Schedule.

When first introduced in the early days of the industry, the foundrymen used what they considered good logic in adopting the sliding schedules. In those days labour was cheap, very cheap, and raw material equally so. Cost keeping or finding was unknown. Moulding methods were extremely slow, and moulding probably constituted the largest single item of cost. That being the case, the pioneer thought that his reasoning was sound when he figured, not having any cost data, that the heavier the casting the cheaper the moulding, the lower the cost, and naturally the lower the selling price. Without taking the time now to point out the all too numerous weaknesses in the above line of reasoning of the early foundrymen—there can be no gainsaying the following statement:—Perhaps the early foundryman did have some justification for his schedule method: we cannot condemn him for trying some such scheme as he blindly ventured forth in a new untried, unknown field of industry. But to-day, with the wealth of accurate, adequate cost data and cost systems available to any foundryman, the continued and widespread use of an archaic method of pricing the product constitutes a sad commentary upon the progressiveness and business ability of the steel foundry industry in general.

A half truth is always attractive and finds ready acceptance. It is for this reason that even to-day countless foundrymen will vigorously defend and attempt to justify the weight schedule. However, a careful consideration of all the items of cost involved in the production of a steel casting will show that the weight schedule is unsound and must go.

Anyone using a sliding weight-schedule in pricing castings is saying in effect that the cost of a casting is primarily dependent on the weight. This is the foundation, the keystone of the arch, of the schedule user. And it is from this angle that it is proposed to attack the weight schedule.

Scope of Paper.

It should be remembered that labour constitutes about one-half of the cost of a casting and let us see if weight is the deciding factor.

The cost of producing a casting is ascertained from the recognised principle of figuring the cost of a particular casting. That is, the actual direct labour charges of the three main departments of foundry production: moulding, coremaking and cleaning, plus the actual overheads applicable to each department as determined by past experience and easily obtained from any reliable set of books. To this, of course, must be added general works overheads and metal cost in accord with the yield of the particular casting, a detailed discussion of this not being pertinent at this time.

Cost of Small Orders.

Besides the above enumerated items, the cost of handling small orders has recently received some consideration. In this respect attention is called to an article sponsored by the Steel Founders' Society of America, "The Cost of Handling Small Orders." The writer is in entire accord with this article, which suggests that single or small quantity orders should carry a minimum service or handling charge of from two to three dollars to cover the cost of putting an order through the foundry. Of course, an order of any consequence is not subject to this service charge, and in considering the cost of producing a casting we propose to eliminate the small or short order and consider the cost of a casting ordered in fair quantities.

Moulding Costs.

The first consideration in this analysis of what determines the cost of a casting is the moulding. The moulding cost per pound or per ton of a particular casting is dependent on several factors, not only on weight, as the schedule-users would have one to believe. One factor and probably the most important in determining moulding cost is pattern equipment. For example, an ordinary floor-job suitable for a 36 in. by 36 in. flask, if mounted on cope and drag boards suitable for jolt moulding, will cost only about half as much to mould in comparison to the cost of running this job on the floor if the pattern is not mounted or cannot be readily mounted. Consider that for a moment—moulding cost doubled if the pattern is not mounted. The first questions a good foundryman asks when figuring on a new job are—What kind of pattern equipment will be provided? How is the pattern constructed? Not, how much does it weigh? Regardless of weight the nature of the pattern equipment is a prime factor in determining the moulding cost per pound of a particular job.

Another consideration is the design of the casting. If it is intricate in design or requires a deep flask, the moulding cost increases. On large castings especially, the requirements of the casting in service raise or lower the moulding cost. If there is considerable machine work on the casting, so that dry sand moulding is required, the cost is greater than if green sand moulding could have been used. Of course, in determining the cost of moulding, weight is not to be entirely disregarded. It is a factor. For example, a hundred-pound casting in a 26 in. by 30 in. flask, other things being equal, will mould cheaper than a hundred-pound casting in a 36 in. by 36 in. flask. But the point as just developed is that weight is not the prime or sole factor that controls the cost of moulding. The kind of pattern equipment, the nature of the design, the requirements of the casting are all vitally determining elements of moulding time. Clearly, weight alone is not the yard-stick to use in measuring moulding cost.

Core-Making

The second great division of foundry costs is coremaking. In the average (American) foundry core costs average about 40 per cent. of the moulding cost. On many castings, however, the coremaking costs more than the moulding. That is because there is a wide variation in the size and number of cores in different jobs. For example, a 50-lb. casting may have a single core costing 2½d. or a 8s. per ton core cost, while a 500-lb. casting may have 12s. worth of cores or a 48s. per ton core cost. Yet under the schedule system the 500-lb. casting should be cheaper because it is heavier. What has weight to do with this? Such variations in core cost are completely ignored in the schedule system.

Core cost is dependent not only on the number and size of cores but also, like moulding cost, on the kind of equipment. Are gang boxes or single boxes furnished; are they whole boxes instead of half; must rods be used; must the core be pasted; all these factors enter into the question of core cost. A question more pertinent than how much does it weigh, is the question: How big and how many cores are in the job?

Cleaning.

The third main division of foundry production, and the one which in most foundries carries the highest direct labour charge, is cleaning. Just as in moulding and coremaking, so also in cleaning, weight alone does not determine the cleaning cost per ton. Quite a few variables determine the cleaning cost per pound of a particular job. The size of the heads and gates, for example, largely determine the cost of grinding, and their size does not vary directly in proportion to the weight, as would be necessary if the sliding schedule were correct. Grinding costs also depend on the location of heads. A lower piece work price can be named if the heads are located on flat surfaces, making grinding easy by affording a good bearing surface, than if the heads cannot be so placed. This depends, of course, on the design and requirements of the particular job, not on the weight.

Chipping and trimming costs also vary with the design. If a casting has numerous cores and if the prints are poorly matched, resulting in heavy fins, or if the parts of the pattern are not accurately matched, or if a mould has been nailed, chipping costs go up. And these "ifs," these contingencies, determine the cost.

Another important item of cleaning cost is welding. In this connection it is interesting to note how completely the weight-schedule users' reasoning falls down. According to them, heavy castings have the lowest welding cost per ton. An analysis of cleaning costs, however, reveals that quite the opposite is the case. Any good fettler will state that there is less welding per ton on a properly rigged production machine casting weighing under twenty pounds than there is on a ton of 500 or 1,000 lb. castings. One reason for this lies in the fact that the majority of the small castings do not require any welding at all, but almost every large casting has some welding and many of them a great deal.

The removal of heads and gates is an expensive operation on steel castings. Acetylene necessary for cutting off large heads and gates is expensive. On the lightweight castings this is not necessary as the heads and gates can be removed either by flogging or else with a sprue cutter. In short, the cost of virtually every division of cleaning: the grinding, chipping, welding and removal of heads and gates, depends on the variations of the particular casting, not primarily on the weight.

Metal Costs.

Having discussed moulding, coremaking and cleaning there remains only one more variable direct charge—metal cost. Metal cost per ton depends on yield in accordance with the rule that the higher the yield the cheaper the metal cost per ton. Here again the weight-schedule theory falls down under scrutiny. With the exception of the ex-

* A Paper read before the American Foundrymen's Association. The author is connected with the G. H. Smith Steel Casting Company, of Milwaukee, Wis.

tremely light castings, the yield is higher generally on small castings than on large castings. Heavy castings require larger heads and gates even in proportion to their increased weight. For example, the author's average yield on castings weighing about one ton is 58 per cent., while the average yield on castings weighing about 20 lbs. is approximately 63 per cent.

The author wonders if he has completely dispelled the delusion of weight determining cost? Does not a careful consideration of all direct labour charges accomplish this? The author has personally estimated, checked, and figured costs on hundreds of different castings of all weights, involving thousands of tons, and one of the cheapest jobs he ever calculated was a 28 lb. hitch casting ordered in quantities of two thousand at a time. Yet, on a weight schedule, a casting in this range would be quite high priced. Now if the cost of a casting does not depend on weight, then it naturally follows that the selling price should not be based on weight. That being the case the method of selling castings on a weight schedule is fundamentally wrong in theory, results in inaccurate, unsound prices and, consequently, is dangerous to use and should be abolished.

Proposed Improvements.

The discarding of the schedule-method of pricing raises the question: Upon what basis then shall castings be sold? The answer to this query has been suggested in the above consideration of the defects of the schedule. It really involves the adoption of two practices. First of all the cost of handling small or short orders must be recognised and provided for. As foundrymen learn to price their product more intelligently, they will inevitably be forced to adopt a handling or service charge for orders up to about ten pieces on light castings. The present system does not begin to reimburse the foundry for the cost of running a small order through the plant. Why then should the foundries carry this burden? Even to-day some foundries are levying a 8s. to 12s. service charge for small orders. The charge is legitimate, and what is needed is to make this practice universal. That would provide for small orders.

The large orders, and this involves by far the greater tonnage, would be sold on a special price for each casting basis. That is, every pattern number would have an individual price, either per piece or per pound. This method, of course, involves figuring the cost of each individual casting. To figure the cost on each quantity order job requires a simplified cost system, adequate timekeeping, and an accurate cost man who also understands foundry practice.

Cost Finding Systems.

If a foundry is using the cost system of the Steel Founders' Society of America* and every steel foundry should be using that system, or one closely allied to it, it is not a very complicated task to figure individual costs. The following data must be compiled: weight of casting, weight of heads and gates, piece work moulding prices, coremaking rates, cleaning room piecework rates, average amount of welding per piece, and any additional work which the particular job may require, such as straightening or trimming. With this data and with a knowledge of overhead burdens in each division of foundry work, as obtained from the cost system, the individual cost of a particular casting is quite readily obtained. All this may sound as though it involves a tremendous amount of detail and office work, but, in reality, once the system is organised and established it can be handled by one man. In the author's foundry, for example, over 92 per cent. of the tonnage is figured individually, and it is one of the large (American) jobbing electric steel foundries.

This method, of course, should also be used in estimating all new work, and it offers an excellent method of checking estimated costs with actual cost. For if an estimated job is obtained the actual cost is run on the job and compared with the estimate. This comparison cannot fail to improve estimating practice.

* This cost system is detailed in an A. F. A., 1928 Pre-print No. 28-3.

While steel foundries and steel castings have been emphasised in this article, due to the fact that the writer's experience has been mainly in steel, the underlying cost ideas advanced apply equally as well to other types of foundries. It is true that each division of the foundry industry has its particular cost problems, but the fundamentals of foundry cost accounting are essentially the same for all foundries.

Better merchandising is the need of the foundry industry to-day. The cost principles and merchandising ideas advanced in this Paper apply with equal force to all branches of the industry; steel, iron, malleable and the non-ferrous branches.

Summary.

In summary, this Paper has endeavoured to prove that the practice of selling castings on a weight schedule should be discontinued, and in its stead a system of selling castings on a special price for each pattern be adopted. Then instead of blindly selling a casting at a certain figure, because it falls within a weight range, the selling price will be based on the actual cost of the particular job, a cost that takes into consideration all the variations and particular features of the particular pattern. Variations which, we have seen, radically affect the cost either increasing or decreasing it. In short, it will be a sounder, better way of merchandising our product.

Economical Melting of Brass Turnings and Buffings.

By "Celsian."

The brass turnings which accumulate in most engineering shops are either melted down by the present-day method of first briquetting into compact blocks, or are simply melted under a layer of heavy scrap. The first system entails the cost of a briquetting machine with hydraulic connections, and the latter results in a heavy melting loss. To review the subject broadly, we generally have the larger works using briquetting machines, since they are fully engaged by the regular source of turnings which is available. Small founders generally cannot reasonably afford a large plant for compressing turnings, etc., and other methods have to be resorted to. These are seldom very satisfactory, and the loss of zinc when melting is often excessive.

The following method has been successfully used in a foundry to some extent. It does not merely represent experimental work, since besides being used for crucible furnaces it has also been applied to reverberatory furnaces. Scrapped copper or brass tubes are first secured. These may either be perished or not, or suitable for re-drawing or otherwise, but should be as free from holes as possible. Whether they are tinned or not is of little importance, as the tin will be added to the alloy formed, as is also the result with any lead present.

The length of the tubes or pipes will depend on whether intended for crucible or reverberatory furnace, and the diameter may vary within certain limits, but the thickness should not be less than a $\frac{1}{4}$ in. approximately. Condenser tubes made of 70/30 brass are not suitable for reverberatory furnace work. Locomotive tubes are usually of the same composition, and are best used for crucible work.

When large lengths of pipes or tubing are bought, they should be cut to the required length without their shape being damaged. This cutting is done with the aid of a "guillotine" or similar cutting machine. The tubes are then bundled together with stout copper wire, in numbers varying with the diameter of the bore. According to the details from one authority, these bundles are placed end up in old basins or hand-baths, and brass borings poured into them. To ensure no spaces being allowed to form, it is advisable to use small borings, chips, etc., rather than long springy turnings. The latter are apt to cause air spaces which might result in explosions, or at least the exertion of great pressure when heat is applied, which would force the borings out of the tube before they were properly melted. An iron rod is usually employed to thrust the chips compactly into the tubes whilst they are flowing downwards. The borings at the top of the tubes are rammed in as tightly as possible, and the bath and tubes lifted bodily and turned upside-down. After removing the bath, the borings at the other ends are rammed tight. The open ends of the tubes are packed with a little small coal or coal dust, so as to protect the metal from oxidation when it melts. The filled tubes are then placed in the furnace, and any scrap to be added for the remainder of the charge placed round the sides or on the top.

Crucible Melting.

If the turnings are from a metal of higher melting point than that of the tubes, the protecting skin of the latter would be fused off, leaving the finely divided metal exposed to the action of the flames. Accordingly, it is necessary to use borings of a lower melting point than that of 70/30 brass. To be on the safe side, it is advisable to melt yellow brass or plumbers' brass borings. So long as the melted turnings can be made to leave the tubes before, or at the same time as the latter collapse with the heat, the object of the foregoing work has been attained. Plumbers' brass should only be used where the tubes themselves have been heavily soldered, since the metal eventually produced will possess lead and tin. Where the tubes are free from lead or solder, yellow borings of a pure quality only should be used. In this way the resulting metal will consist of a pure copper-zinc alloy, and if the zinc of the borings burns off, as it usually does, the composition will be approximately 70/30 brass. Should it be lower in copper than 70 per cent., an addition of 80/20 brazing metal scrap can be made. It is a bad practice to add copper directly to any rich zinc alloy, as, apart from other considerations, the melting point is raised unnecessarily to a much higher degree than is required. Forced-draught crucible furnaces have to be kept well in hand for this work, as an undue raising of the temperature would cause the outer skin to melt and run off before the heat had time to soak inwards. The object of bundling several tubes together is that only one side of the outer tubes is directly exposed to detrimental influences, and the bundle literally resembles that of a block of solid metal.

Reverberatory Melting.

In some furnace work the bed is heated up first before the charge is added, but in this instance (with the reverberatory) it is much better to charge into a cold furnace, as the tubes are an awkward shape, and require some time to be placed in proper position. The furnace used is the ordinary type of reverberatory, as is used for refining scrap brass, etc. Scrap copper tubes only are used in this instance. After charging the metal, a fire is kindled, and splint coal added. The flame is deflected from the roof on to the bed in the usual manner, but care should be taken that the bulk of it lands on the middle portion of the tubes. If it were to strike the ends of the tubes, the progress of the flame would be retarded, and at the same time the small coal would get burnt out, leaving the metal liable to become oxidised.

The object in using copper tubes is that the brass, gunmetal, etc., of the turnings will melt and run out before the temperature is sufficiently high to melt the copper. If the temperature could be very accurately controlled, the tubes might be left unaltered, and used for succeeding charges. This is practically impossible when working with the ordinary type of reverberatory, and the smelting is considered successfully accomplished if all metal is melted out with a minimum loss.

The metal which flows to the well will consist of a brass or gunmetal with a rather high percentage of copper. A sample of the molten metal is lifted from under the surface of the slag with an iron spoon, and then chilled in a pail of water. It is bored and rapidly analysed, after which a calculation is made of how much zinc, tin or lead are required to bring it to a known composition.

An order for two Diesel-electric locomotives for the North-Western Railway, India, has been secured by the General Electric Company, Limited.

Pyrometers for Surface Temperature Measurements.

The accurate determination of the temperature of a heated metal surface is a problem which presents considerable difficulties. Until recently such temperatures could only be measured, with any reasonable degree of accuracy, by adopting elaborate methods, which, although suitable for use in research and testing laboratories, could not be employed under industrial conditions for routine measurements.

As a result of systematic investigations into the problem, the Cambridge Instrument Company, Limited, 45, Grosvenor Place, S.W.1, have recently devised and patented a new form of pyrometer which enables the temperatures of hot surfaces to be measured with an ease and rapidity hitherto impossible. This pyrometer is made in a number of patterns, some of which we illustrate below. Its principal features will be best understood by first considering the chief difficulties involved in the measurement of surface temperatures. The main difficulty usually lies in the fact that, at the surface of a solid body, the physical conditions suddenly change, and, consequently, the temperature gradient is steep. A metal surface forms a boundary, on one side of which is a solid medium forming a good conductor of heat, while on the other side is air, which is a bad conductor. If an ordinary mercury thermometer is applied to the surface the glass wall of the thermometer bulb prevents the mercury from coming into direct contact with the metal, and it is merely the air temperature at some distance from the surface which is measured. The area of the thermometer in contact with the metal is also small compared with the area exposed to the air, and, therefore, much of the heat received from the metal by conduction is lost. This latter source of inaccuracy is also present if a thermo-couple of the ordinary "poker" type is applied to the hot surface, and there is the added disadvantage that the heat lost from the hot junction, by conduction along the wires of the thermo-couple, is still more serious in amount.

Although these disadvantages have long been realised, the majority of the temperature-measuring instruments hitherto designed for taking surface temperatures have been based upon one or the other of these two methods, certain precautions, such as the provision of large contact surfaces and heat-insulating packing, having been adopted to minimise the errors. Even with the best instruments of the types referred to, however, reasonable accuracy is only obtained at the expense of rapidity in reading, several minutes usually being required to obtain a steady reading after the instrument is applied to the hot surface.

Fig. 1.—Standard Surface Temperature Pyrometer.

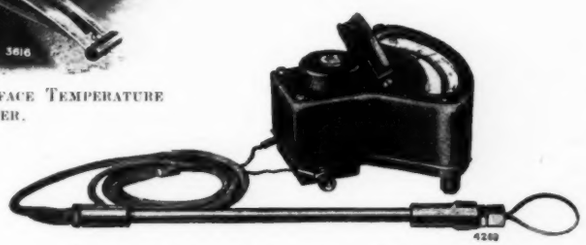


Fig. 2.—Surface Temperature Pyrometer Provided with a Loop for Use in Confined Spaces, such as are Encountered in Die Casting, etc.

Overcoming Contact Difficulties.

In the majority of the instruments described below, which are of the thermo-electric type, accuracy and rapidity of reading are secured by utilising a novel thermo-couple, in the form of a thin and comparatively wide strip of metal, 0.01 in. thick and 0.25 in. wide, which, when applied to a heated surface, takes up its temperature almost instantaneously. The thermo-couple consists of pieces of copper and constantan (or other metals having suitable thermo-electric characteristics) welded together end to end, and rolled out so as to form a flexible continuous strip with a smooth surface on both sides. The strip is supported, under spring tension, in a frame which forms a convenient handle. The hot junction is at the centre of the metal strip, and when the thermo-couple is allowed to rest lightly upon the heated body of which the temperature is required, the strip conforms to the shape of the body, so that a portion of the strip, approximately 4 in. long, extending on either side of the hot junction, is in intimate contact with the hot surface. The area of contact is thus so large that the heat conducted away along the strip is fully supplied from the portion of strip in contact, without any heat being lost from the actual hot junction. Further,

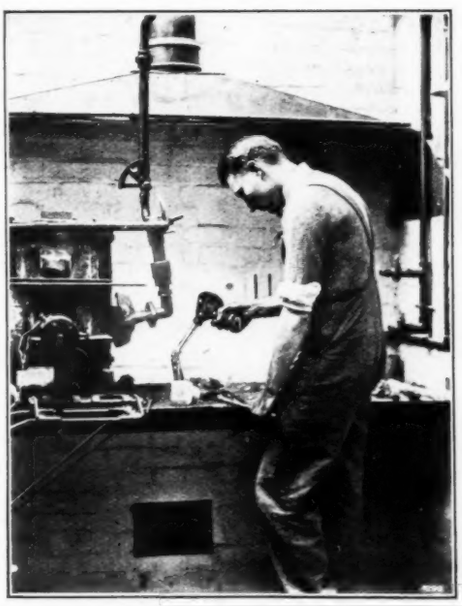


Fig. 3.—A Type of Pyrometer Suitable for Measuring the Surface Temperature of Small Billets or Ingots.

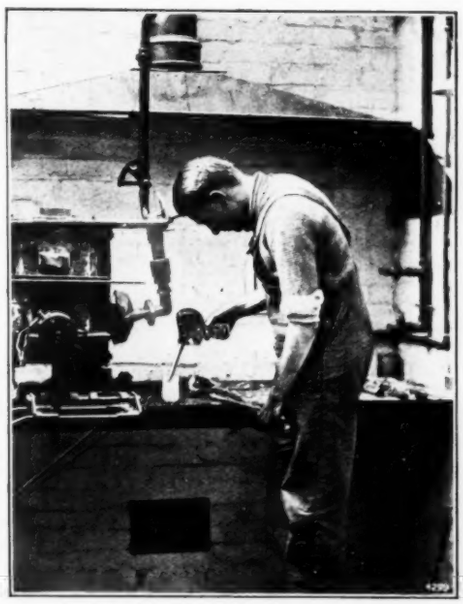


Fig. 4.—Pyrometer for Measuring the Surface Temperature of Non-Ferrous Billets and for taking "Spot" Temperatures at various points.

since the strip is so thin in comparison with its width, the area of radiation around the hot junction is practically equal to the area of contact, and the rate at which the heat is radiated from the thermo-couple, therefore, closely approximates to the rate at which it is radiated from the hot surface under test; the thermo-couple thus practically forms a part of the actual hot surface. The conditions obtainable in this way approximate very closely to those given by the "poker" type of thermo-couple when totally immersed in molten metal, and similar rapidity of response is secured. On a clean surface it has been found that a steady reading can be obtained in from three seconds to five seconds after the thermo-couple has been applied. Other advantages of the strip thermo-couple which may be mentioned are that, since the strip is of metal and does not require any heat-insulating packing behind it, there is no blanketing effect, so that its application to the heated surface does not cause a "hot spot," with its consequent effect on the accuracy of the temperature reading.

Modifications for Industrial Utility.

The instrument shown in Fig. 2 is designed for taking the temperatures of chills and permanent cast iron moulds, etc., and internal or concave surfaces where the small self-contained surface pyrometer illustrated in Fig. 1 could not readily be employed owing to the confined space. The thermo-couple is bent in the form of a loop, 2 ins. in diameter, at the end of an aluminium handle, which may be any length from 18 to 12 ins., and is supported on a steel strip, which is made flexible, thus allowing the loop thermo-couple to conform to the shape of the surface to which it is applied. It is connected (by means of a length of flexible leads) to a millivoltmeter calibrated to read directly in degrees of temperature. The handle is so designed as to prevent the conduction of excessive heat to the hand, and the leads are protected from damage by armoured sheathing; kinking of the leads being prevented by a spring at the end of the handle. Usually the thermo-junction is arranged at the centre of the loop, but when an instrument is required for measuring the temperature of internal surfaces it is sometimes more convenient to arrange the junction at the side of the loop, in which case the loop is shaped eccentrically to facilitate its application to the hot surface.

For taking the temperature of small steel billets for files, etc., and where only a very small heated surface is available, the smaller thermo-couple, shown in Fig. 3, may be used. In this instrument the thermo-couple strip is made in the form of a small elongated loop (about ¼ in. wide), and is protected by a four-sided metal case with a wedge-shaped opening at the extremity. Two of the edges of the opening project further than the other two, and are of chisel form, so that in applying the instrument to a billet any slight scale may be first scraped off and then the thermo-couple is pressed into definite contact with the clean surface, the temperature of the billet being then shown on the indicator scale.

The indicator is embodied in the handle of the instrument, at the rear end of the thermo-couple, the complete instrument having the shape of a revolver. A "revolver" grip is provided, moulded to the hand, so that the thermo-couple may be firmly applied with one hand, leaving the other free for manipulating the material under observation. The scale is arranged edgewise at the back of the instrument, with the figures upright, so that it is directly in the line of sight when the thermo-couple is applied to the surface, and can be read at a glance. It can be calibrated for practically any temperature range between 0 deg. C. and 800 deg. C., or corresponding Fahrenheit ranges. The complete self-contained instrument weighs very little, and forms a compact and portable unit, which is not liable to damage from rough usage in the foundry.

An interesting test of this type of surface pyrometer was carried out recently at a large Sheffield steel works. The object was to control the manufacture of steel plough coulters, which are large convex metal discs about ¼ in. thick and 14 in. in diameter, and are tempered by heating to about 760 deg. C. and oil-quenching. The process is usually controlled by taking the time of immersion in the furnace and noting the colour of the metal. Several readings with the pyrometer gave results averaging 665 deg. C. (± 15 deg. C.), but a reading on one disc, the colour of which was hardly perceptibly different from the others, was 550 deg. C. It was thus proved that it was possible to get a disc hot to the eye and yet too cold in reality, owing to insufficient soaking. In an additional test in the same works, a number of readings were taken on files in the file hardening department, as they were withdrawn from the lead pots and forges. The tests proved the utility of the instrument in cutting down the amount of wastage, and since readings could be obtained without preparation, it was found possible to prevent any attempt on the part of the workmen to do their best work only when a test was being taken, so that the tests revealed the actual quality of work being obtained during the ordinary routine, and enabled steps to be taken to improve the quality.

Non-Ferrous Applications.

For non-ferrous metals and for taking the temperatures at a number of points on the same surface, the pattern illustrated in Fig. 4 is used. As will be seen from the illustration, this is of similar form to the pyrometer shown in Fig. 3, but the strip thermo-couple is replaced by two sharp metal prongs embodying the wires forming the thermo-elements, and protruding from a cylindrical barrel, the actual thermo-junction being completed by the surface of the metal against which the prongs are pressed. One prong normally projects from the barrel further than the other, being kept in this position by a spring. By this means definite contact of both prongs is ensured even when applied to rough or uneven surfaces. The distance between the prongs is made so small (about 4 mms.) that in the majority of cases there is no likelihood of inaccuracies due to variations in the conductivity of the metals under test.

The possibility of obtaining accurate knowledge of the actual temperatures of metals during the process of heat treatment and at various stages in the course of production, possesses distinct and important advantages which will be obvious to all experienced foundry and metal workers. It is probably not overstating the case to say that by the intelligent and systematic use of surface pyrometers, such as those described, much wastage, due to inaccurate temperature estimations, may be eliminated, and appreciable improvement both in quality and quantity of products may be obtained.

Many other surface pyrometers have been produced by the Cambridge Instrument Company, Limited, covering various specialised processes, and information regarding these will doubtless be forwarded to those interested on application.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Iron Making in the Middle Ages.

To the Editor of The Foundry Trade Journal.

Sir,—In my letter published in your issue of June 21 I quoted from the account roll of the old ironworks at Byrkenott, near Bedburn, County of Durham, covering the period June 12, 1408, till November 11, 1409, an entry about a payment for carrying cinders from Hopyland Park to the forge for tempering the new iron made there (*pro ferro novo ibidem temperando*). I am now in a position to throw some light on this process of "tempering." As recently as 1893 the Hungarian Geographical Society published an ethnographical study by the late Dr. Jankó, in which this author described the way that iron was made in his days at Toroczkó in Transylvania. The iron makers there boasted that their process had not been changed since they left their old home in Styria some two centuries before. Briefly it may be described as follows:—

The ironstone mined locally was screened, and the screenings sent in baskets on horseback to the forge for finishing the iron made; the screened lumps were taken, also in baskets on horseback, to the smelter, which was a circular furnace about 9 ft. high, lined with some refractory clay also got locally. To start with, the whole of the furnace was filled with charcoal, which was set alight, but no ironstone was added until the whole of the fuel became an incandescent mass and began to settle down. The ironstone was then charged into the furnace in layers alternating with layers

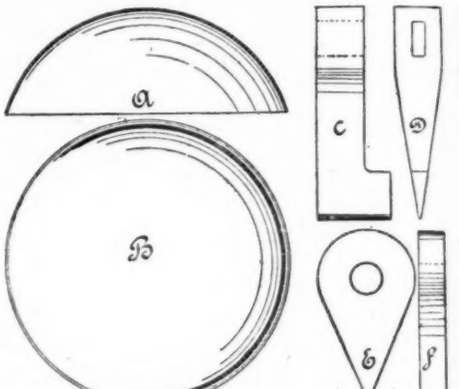


Fig. 1.

A. Elevation, and B. plan of iron loaf.
C. Side view, and D. end view of axe for cutting the iron loaf.
E. End view, and F. side view of wedge.

of charcoal, the quantity of the fuel depending on the refractoriness of the ore. After about twelve hours' working, during which time the required blast was provided by means of bellows driven by a water wheel, the burden had settled down, the brickwork closing the mouth of the furnace was removed, and the lump of iron accumulated at the bottom was dragged out by means of iron tongs 9 ft. long (the "tow irons" mentioned in the old Durham account), placed on a block and covered up with charcoal dust to prevent it getting chilled. Owing to its peculiar shape the lump of new iron was called an iron loaf or loaf iron. It was a round loaf 600 mm. (nearly 24 in.) in diameter, and formed part of a sphere about 220 mm. (9 in.) high at the centre. After a time the loaf was cut in two with an iron axe assisted by an iron wedge; the pieces were taken to the forge proper where they were placed in charcoal dust in another furnace (called the "stryngheart" in the Durham account roll) and occasionally covered with the screenings from the ironstone and blown by another set of bellows; they were then forged with hammers worked by a waterwheel and turned into wrought iron, which was worked up into ploughshares, coulters, and similar objects. No castings were made at Toroczkó.

The object of covering the new iron loaf with charcoal dust was, as already stated, to prevent it getting chilled and too hard to be cut. If, in spite of such precaution, the loaf got too hard, it had to be sent to the iron-hammers to be cut.—Yours, etc.,

Historian

Catalogue Received.

Aluminium Pressure Die Casting Machines.—The Universal System of Machine Moulding Company, Limited, of 13-15, Wilson Street, London, E.C.2, have sent us a neat little brochure dealing with their latest speciality—a die casting machine. If a mistake has been made at all it is that too much space has been devoted to the general superiority of the die-casting process over the sand-moulding method and too little about the actual machine itself. The booklet does, however, claim very close temperature regulation for the metal and dies, which is of paramount importance. Another interesting detail of the machine is that the maximum size of casting possible by the standard type is 9 in. × 14 in. and weighing a maximum of 1¼ lbs. when turning out "aluminium" castings. An increased weight can be dealt with if the nature of the casting permits of lower than standard pressure being used.

London Metallurgists Discuss Cylinder Problems.

Mr. Cook's Paper, "A Talk on Cylinder Metal"* induced a lively discussion when he presented it to the London Branch of the Institute of British Foundrymen, over which Mr. W. B. Lake presided, who opened by stating that in many Papers there was much theorising and an avoidance of many of the vital points, but Mr. Cook had gone to the heart of his subject, and had told his hearers the why and the wherefore of it from beginning to end.

Mr. H. J. Skelton (Chairman of the Management Committee of the London Iron and Steel Exchange) recalled an occasion on which the famous Sherlock Holmes, having been presented by Dr. Watson with certain facts, had said, "Excuse me, my dear Watson, if I prefer my deductions to your facts." All his life, said Mr. Skelton, he had been gathering certain facts from practical foundrymen. He had realised that there were different kinds of cylinders, that the kind of iron one would use to make a hydraulic cylinder was not the iron one would use to make a steam engine cylinder, and certainly not the iron one would use to make an automobile engine or a Diesel engine cylinder, but Mr. Cook's ratios had brought home to him the full meaning of those facts. He would be delighted to test out Mr. Cook's ratios—which would be very valuable to all foundrymen—in accordance with his practical facts.

Effects of Phosphorus.

Mr. A. C. Dews, said his experience on the question of phosphorus content was not quite in accord with that of Mr. Cook. He gathered that Mr. Cook, when dealing with phosphorus, had been dealing almost entirely with its effect upon the strength and wearing properties of cast iron rather than upon the casting properties, but certainly his own experience in the making of castings to withstand very high hydraulic pressures was that high phosphorus was detrimental. He agreed that the range round about 0.5 per cent. was certainly very dangerous from many points of view, and from a casting point of view anything over 0.40 per cent. seemed to him to be very disadvantageous. Probably the silicon-carbon ratio had something to do with Mr. Cook's conclusion that a high phosphorus content was suitable; his own experience, which had extended over a number of years, would suggest that. The question of the effect of superheat on metals was one which had interested him very much, and the experience of his firm had been that cast iron of any form, whatever the analysis, was quite unsuitable for superheat. He would like Mr. Cook to give a little more information, therefore, on the effect of superheat on the cylinders he had referred to.

Mr. Cook said he had not dealt in his Paper with special alloys, involving additions of nickel and chrome, etc., but all these had been tried from time to time. He agreed with Mr. Dews that, when speaking of phosphorus content, he was referring more to the physical properties than the casting properties. The fact he had emphasised was that on one condition, *i.e.*, that the silicon-carbon ratio was in the right direction, one could ignore phosphorus even for high duty Diesel work. He had referred in the Paper to a phosphorus content of 1.34 per cent., but had aimed at 1½ per cent. In the ordinary way he would not have added that. In the case referred to, however, these were two engines which had never given good results, and they provided an opportunity to try out the theory of metal with the carbon-silicon ratio standing up in the presence of high phosphorus. If those engines, after being re-conditioned, were still useless, no harm was done, but the fact remained that by keeping the ratio down these cylinders, with even 1.34 per cent. of phosphorus, had worked excellently. Mr. Dews, when stating that more than 0.4 per cent. phosphorus was dangerous in hydraulic cylinders, was dealing with a problem totally different from that discussed in the Paper; the thickness of the metal in the cylinders discussed in the Paper varied from ¾ to 1⅛ in., whereas the thickness of metal in hydraulic cylinders might be anything up to 4 or 6 in.

Mr. Dews said his remarks did not apply to hydraulic cylinders, but to other hydraulic work, such as valves.

Mr. Cook replied that in that case the metal was still over 1¾ in. thick.

Mr. Dews disagreed, and said it was less.

Mr. Cook said he would not mind making valves containing over 1 per cent. phosphorus which would stand up to the work. With regard to superheat, he said his firm had used steam up to and over 350 lbs. pressure, and a maximum temperature of 300 deg. C. and over without any physical detriment to the cylinders; in fact, the trouble with these temperatures is not due to the metal but owing to the difficulty with the carbonisation of the lubricant.

Mr. V. C. Faulkner said it could be taken for granted that the phosphide eutectic melted at 950 deg. C., or thereabouts, and one heard of cases in which cast iron had been used for case-hardening boxes and where the phosphide eutectic had actually left the iron and had dropped on to the steel bars which had been case-hardened, thus spoiling them. He asked if it would be possible—when putting engines through test—with high phosphorus and but little lubrication to reach a temperature higher than that at which the phosphide eutectic melted and spoiled the casting. He also asked Mr. Cook if he had any definite objection to a high manganese content, because it would appear, judging from the literature of the world, that for cylinder work high manganese was favoured. Would Mr. Cook hold definitely that low manganese was to be preferred for cylinder work?

Influence of Manganese.

Mr. Cook, dealing with the question as to the manganese content, said he adhered to his statement that one must keep in mind always the fundamental necessity of keeping the silicon-carbon ratio correct. It might be said that he was probably prejudiced because he was dealing with chill cylinders and had to keep the manganese content low, but he had also studied manganese content from the point of view of wear, and it would be found that generally where people were advocating high manganese their silicon-carbon ratio was wrong. It was fatal to put in high phosphorus when the silicon-carbon ratio was wrong; when that ratio was correct he did not think the phosphorus mattered at all, not even with high degrees of superheat. If the ratio was wrong to start with, high manganese was beneficial, and if the phosphorus content was low one would get comparatively good results. The third cylinder his firm had made for the first Diesel engine, in order to prove the point, was made in accordance with the German practice, and that cylinder, whilst it was not worn out in six weeks, had worn far enough by that time to prove that it was not a good wearing cylinder. His firm's experience with the German engine, which had high manganese and low phosphorus contents, and which worked only at week-ends and not when the boiler was going, also confirmed his point. It had not the correct ratio of silicon and carbon, and although it was comparatively good it gave very much worse results than the one made by his firm, and having a very low manganese content. Everything he had said in the Paper was based on the assumption that the ratio was correct.

Mr. H. G. Sommerfield (Hon. Secretary), referring to Mr. Cook's silicon-carbon ratio, said he supposed that was the silicon-total carbon ratio, and he asked whether, with varying percentages of combined and graphitic carbon, the ratio would be upset. He was glad Mr. Cook had dispelled the idea that high phosphorus and sulphur were invariably detrimental. A case which confirmed Mr. Cook's experience had come within his knowledge some 18 years ago. A locomotive cylinder, which had been in use in England for about 28 years, was dismantled, and drillings were analysed. It was found that the phosphorus content was slightly above 1 per cent., the sulphur content was 0.22 per cent., and, so far as he could remember, it had quite a medium manganese content. He was very glad that Mr. Cook had emphasised his experience in that connection.

Mr. Cook, replying to Mr. Sommerfield, said he should have pointed out in his Paper that total carbon had a very great bearing on the physical properties of the metal. Dr. Stead had given examples showing that every 0.1 per cent. of graphite had decreased the tensile strength by 15 cwts. If the ratio were right, then, the other elements being normal, it would keep the combined carbon normal—within the thicknesses of which he was speaking. He was dealing with metals cooling at practically the same rate, and, therefore, the ratios kept the combined carbon quite normal. Commenting on Mr. Sommerfield's reference to some old cylinders which, although they had worn well, had had very bad chemical analyses, he said that the wearing qualities of cylinders were very difficult to foretell. There was no test that he knew of which would prove whether or not a metal would wear well, other than that of practical running experience. His firm had had a thorough investigation made by an eminent scientist, lasting three years; there was not a deduction made which could not be easily upset, and they had tried very hard to find a test for wearability. It was not unusual to find old cylinders which, in spite of seemingly unsuitable analyses, had given very good results in practice. That might be explained partly by the fact that they were made of cold blast irons, as against hot blast irons. To-day, however, one could make a cylinder wear well, whether it had a bad analysis or a good one, by starting off properly. One could spoil a Diesel engine on the test plate, no matter what it was made of. On all new motor cars to-day there were notices warning the owners not to overspeed the engine, but to run it in gradually, if they wanted the best wearing results; indeed, he believed that in the case of the Rolls Royce the engine was so made that one could not overspeed it. When he was an apprentice the engines were run in for perhaps six weeks with very low steam pressures, and simply swamped with oil; they were run slowly until they had attained a high polish. One could produce a high polish on a good, bad or indifferent iron if one ran it in properly, and once that high polish was produced it would stand up to wear. To-day, perhaps, when the inspector came to see an engine of, say, 1,000 h.p., the steam pipe was not coupled up after this was completed, the engine would be barred round once or twice to ensure that everything was clear, then run round with a little steam and then turned straight on to full load, with superheat, and it required good metal to withstand these exacting conditions.

Mr. H. J. Skelton referred to some hydraulic cylinders which, when made with the best possible irons, were found to sweat, whereas similar castings made with cold blast pig-iron produced no evidence of sweating. He asked if Mr. Cook could explain why two irons which were comparable, except that one was made by the hot blast and the other by the cold-blast process, should differ in that way.

Mr. Cook replied that sweating or absence of sweating in a hydraulic cylinder depended upon graphitisation, *i.e.*, the size of the flakes. A manganese content of 0.4 per cent. would give a certain graphitisation. Within the range of from 0.4 to 1 per cent. of manganese the graphite flakes should be smaller, but, in fact, they frequently became abnormally large; although the quantity of graphite was the same as before, the flakes were very much thicker and coarser, and as a result the cylinder would sweat. If the manganese content were increased to 1.7 per cent., however, one reached a range within which the graphite was again refined. He should say that between 0.4 and 1 per cent. of manganese there was a tendency towards bigger flakes of graphite, although there would probably be more combined carbon present as the manganese content increased.

Mr. J. W. Gardom (Branch Vice-President), after expressing his thanks for a most enjoyable lecture, said one felt that one dare not criticise Mr. Cook's mixtures, because he had said that he had made cylinders with them for a great number of years and that those cylinders had been successful, but it did appear that he had

* This Paper appeared in Vol. 38, No. 615, Page 385.

started off with a certain formula and had made everything synchronise. He had created the silicon-carbon ratio, and had made everything else so fit in that by the time he had finished his phosphorus and manganese contents and so on were not in accordance with those of anyone else. Had he started the other way round he would probably have got results just as good. Everything depended upon the amount of graphitic carbon for a definite thickness, and by varying the silicon-carbon ratio, and at the same time varying the manganese, sulphur, or even phosphorus to a small degree, one still maintained the graphitic carbon ratio. It seemed that Mr. Cook had definitely proved that the analyses could be travestied about and could still be made to give good results. With regard to Mr. Cook's sulphur-silicon ratio, which he had given as 1:10, and his suggestion that the best ratio for malleable iron was 0.6 per cent. silicon and 0.06 per cent. sulphur, Mr. Gardom said he did not think one could have anything worse than that in malleable iron from the point of view of wearability. Mr. Cook must have been speaking of the annealed malleable iron, however, as the white iron, as cast, was extremely hard. The problems of annealing and so on were not entirely dependent on the analysis.

Mr. Cook agreed that if one started off with the wrong silicon-carbon ratio one could correct it to some extent by varying the quantities of the other elements, and said that that was what other people had done, but he contended that the right formula was the one he had given, and that if one started off with the right ratio one would obtain better results than would be obtained by starting with the wrong ratio and correcting it by varying the other elements, such as manganese and so on. He could not find anyone else who could give absolutely daily results over a period of 27 years which would compare with those he had given. The keynote to the success of the iron, he was convinced, was the silicon-carbon ratio; if the ratio were wrong one started with a worse basis, and had to resort to devices which were not good. He had not suggested in his lecture that 0.6 of silicon and 0.06 of sulphur in malleable iron would give good wearing properties, but that it gave fairly high physical properties, as far as tensile strength was concerned. When referring to the sulphur-silicon ratio as 1:10 he was referring to Coe's work, which had nothing to do with cylinder irons; the purpose of that work was to show the effect of sulphur, and where that ratio had predominated the highest physical results had been obtained.

Mr. Griffiths said that this was the first time he had had the pleasure of attending a meeting of the London Branch, and if Mr. Cook's lecture was a sample of what the Branch could provide, he would endeavour to attend more frequently. He regretted that Mr. Cook had not discussed alloy irons, to which nickel, and so on, had been added, but perhaps Mr. Cook would be able to give some data on such irons on a future occasion.

Mr. Cook said the subject was a very wide one, and he had not been able to touch on the constitutional analyses, which were very interesting, nor had he been able to deal with alloy irons, to which various elements, such as chromium, nickel, etc., had been added, but most of the well known alloy irons had been tried. Mr. Griffiths was associated with him in connection with some research now being carried out on the addition of nickel to the particular analysis of iron dealt with in his lecture, and no doubt some very valuable information would be obtained in due course. Those who were members of the British Cast Iron Research Association could look forward to receiving some very interesting information in this connection, but, inasmuch as the work was not completed, he was not permitted to say anything about it.

Vote of Thanks to Mr. Cook.

Mr. Bagshawe, proposing a vote of thanks to Mr. Cook for his lecture, said there had been a good deal of chipping from time to time as to the value or otherwise of the metallurgist or scientific man in the foundry, and it was very interesting to hear Mr. Cook, who was not, he believed, a man whom one might call a trained metallurgist, dealing with subjects which were often regarded as subjects for the trained metallurgist, and which the ordinary foundryman could not deal with. Mr. Cook's lecture had proved that if foundrymen would take the trouble they might learn something of this scientific work, perhaps not to the extent that Mr. Cook had learned it, but sufficient to help them considerably in the solution of their every-day problems. Another point made by Mr. Bagshawe was that there was not sufficient criticism of the papers read at the meetings of the Branch; most of the criticisms were made by those who had scientific interests, but greater efforts should be made by the general body of members to enter into the discussions. It did not matter if others disagreed with their remarks; they would probably help some other fellow who was in a hole and did not like to ask questions. If that were done, he believed the Institute would do more good even than it had done in the past. Finally, he expressed the hope that Mr. Cook would lecture to the London Branch again in the near future.

Mr. G. C. Pierce (Past Branch-President) seconded the vote of thanks. Referring to Mr. Cook's reference to the cornering of the foundry foreman, he said that as a foundry foreman himself he would return the compliment and suggest that after that evening's experience one or two gentlemen would be getting Mr. Cook into a corner. (Laughter.) He regretted that Mr. Cook had not been able to extend his lecture, in spite of the shortness of time, but hoped that when Mr. Cook received an appeal from the Branch Secretary next session he would not forget that many members of the Branch would be pleased to hear him again.

Mr. H. G. Sommerfield (Branch Hon. Secretary and Treasurer) said Mr. Cook must consider himself booked for next session.

The vote of thanks was accorded with acclamation.

Mr. Cook, responding, said it was very gratifying to know that his efforts had been valued so highly. It was probably within the recollection of some of the members that he had read the first paper contributed before the London Branch, and had read others since. Commenting on Mr. Bagshawe's remarks, he said there was very little science in the foundry before the formation of the Institute, and when he had commenced to study some of the problems he had dealt with in his lecture he had been unable to find any scientific help. He was not a scientific man, but always tried to apply common sense to his every-day problems. Mr. Pierce's remarks as to the cornering of the foundry foreman suggested that he had been misunderstood. His anxiety was to help the foreman; if a foreman came across a problem which was likely to corner him, he helped him to study it so that he could avoid being cornered in the future. He had always endeavoured to work amicably with his foremen, who had had his confidence, and he did not try to trap them.

The meeting then closed.

The Manufacture of Alloy Steel.

Ingot Casting.

In the course of a Paper read recently before the American Iron and Steel Institute, at New York, on "The Manufacture of Alloy Steel," the author, Mr. E. C. Smith, after some general remarks on the subject, points out that both the major processes—open-hearth and electric—deliver from the furnace sufficient metal to make the operation of teeming a very important factor in the production. To the author the pouring of steel has always seemed the orphan of the steel business. Physical chemists have studied the reactions of the blast-furnace. There is some information concerning open-hearth conditions, heating, rolling and treating. We can get direct expressions from mill men or metallurgists on nearly any phase of the steel business with the single exception of ingot-casting. The factors of temperature, nozzle size, pouring speed, mould design, solidification rate, sinkhead design and their relation to the various chemical compositions are very vague. Individual plants specialising in ingot-casting have made some progress, but in general less specific information exists on this point than on any other.

Alloy steels are almost without exception killed steels. As such they are cast in sinkhead ingots. Considerable tonnage is cast in the big-end-up ingot, probably best typified by the Gathmann type of ingot mould. The sink-head design varies, but for the rolling type of ingots may be considered standard as typified by the Turner brick-top mould. The volume relation of sinkhead to ingot varies slightly, but is nearly 15 per cent. of the gross volume of the liquid steel. Mould design varies from plant to plant, but an increasing proportion of fluted ingots for special steels are encountered. The larger ingots for forging work are almost all fluted, although size may prohibit the big-end-up type.

Conventionally a special steel may be said to be poured into a big-end-up mould whose walls are not thick, top area of mould to ingot is about 1¼ to 1, or 1 to 1, while the bottom area of mould to ingot will approximate 2 to 1. The length below the sinkhead may be three times the diameter. The length-diameter ratio even at 2 to 1 is questionable, but it is hardly practical to work such short ingots into billets. The sinkhead usually provides for considerable metal in excess of the pipe-cavity requirements, but low efficiency must be faced to permit sufficiently rapid freezing to eliminate undue carbon segregation immediately under the sinkhead. The entire ingot design is on a scale very small compared with commercial steels. Conventional ingots would be 20 in. dia., weighing gross less than 5,000 lbs. In fact, any ingot in excess of 7,000 lbs. gross must be considered large.

The problem of freezing time, or period after pouring before stripping, while interesting, is usually ensured by the fact that the conventional ingot solidifies comparatively quickly, due to its small size. One and one-half hours after pouring the 20-in. ingot is practically solid. The time of removal of sinkheads, stripping, usually ensures solidity before charging.

The varied composition of alloy steels imposes on the rolling-mill crew the definite routine of rolling from predetermined temperatures. The rate of conductivity is low and the heating time is long. These factors are usually cared for by providing experienced optical pyrometer operators to furnish temperatures to heaters both at pits and at bar-mill furnaces.

The blooming-mill operations differ from those for commercial steel in that smooth rolls are essential. In the ingot of the future, where the skin will stand more punishment, ragged rolls may be used, but under present knowledge of the art the smooth roll is essential. Reductions are lighter due to both lack of ability to bite the ingot and for the protection of the material. About double the number of passes on the mill are used in breaking down from ingot to bloom.

Alloy steels are, commercially speaking, not capable of being fire welded. The skin of the ingot is sensitive and when broken the rupture has no tendency to heal. Every break in the surface means a defect to be removed from the billet prior to rerolling or forging. This is done in the same manner as in commercial steels by chipping or grinding. The requirements are somewhat more exacting, due to the intangible physical characteristics. It may be expected that the commercial steel user of the future will demand the same standard; in fact, he does at present.

Werner Medal Award.

Herr August Diefenthaler is this year's recipient of the Siegfried Werner Medal, the award of which is in the hands of the German Foundry Employers' Federation. Mr. Diefenthaler, who is now retired, was for many years the foundry manager at the Lanz Works at Mannheim. It was towards the end of his career that he was granted patents for his method for producing hot mould cast iron, now so well known as Lanz Perlit.

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TELEPHONE: MIDLAND 170.

Trade Talk.

The I.A. Maffey of Munich has received an order for 22 locomotives for the Eastern Bengal and the Bombay, Baroda and Central India Railways.

The General Electric Company, Limited, have secured, in face of keen Continental competition, an order for two Diesel-electric locomotives for the North-Western Railway, India.

The Poldihütte in Czecho-Slovakia has established its own special selling agency for Belgium and Luxemburg, under the title of Aciéries Poldi Soc. Anon., with a share capital of 250,000 fcs.

Messrs. Penwyllt Silica Brick Company (1927), Limited, have now registered under the name of the Craig-Y-Nos Silica Brick Company, Limited, under which title they will in future trade.

The New South Wales Government Railways have ordered 1,000 tons of manganese steel rails from Hadfields, Limited, Sheffield. The rails, which are of the Australian standard section, are to replace ordinary steel rails now in service.

The agents of the Tata Iron & Steel Company, Limited, report that the total approximate production of the works at Jamshedpur during May was 43,810 tons of pig-iron, 43,033 tons of steel ingots, and 19,058 tons of finished steel.

Messrs. Cammell, Laird & Company, of Birkenhead, have received an order from Messrs. Elders and Fyffes, London, for two large passenger and fruit-carrying steamers for service between the West Indies, Central America, and this country.

Messrs. Pease & Partners have given notice to the blastfurnacemen employed at two furnaces at their Tees ironworks, Middlesbrough. This firm are also closing down their ironstone mine at Ayton, which was reopened only three months ago after a lengthy period of idleness.

An order for 20 locomotives for the Egyptian State Railways has been placed with the Italian firm, Ernesto Breda, at a cost of £4,579 each. The lowest British tenders for the locomotives were those from the North British Locomotive Company, Glasgow, £5,295; W. G. Armstrong, Whitworth & Company, £5,420; Robert Stephenson & Company, Limited, Darlington, £5,455.

Automatic and Electric Furnaces, Limited, Elecfurn Works, North Road, Holloway, London, N.7, inform us that an arrangement has been entered into between Messrs. Vickers-Armstrongs, Limited, Broadway House, Westminster, S.W.1, and themselves whereby Automatic and Electric Furnaces, Limited, will demonstrate and sell the Vickers-Armstrongs hardness testing machine.

The Power Gas Economy Company, of Glasgow, inform us that during the last month they have booked orders for Hunter gas-burners to burn coke-oven gas from the following firms:—Richard Thomas & Company, Limited, Redbourn Works, Scunthorpe (equipment for 12 boilers); Nunnery Colliery Company (equipment for two Babcock boilers); Guest, Keen & Nettlefolds, Limited, Dowlais (equipment for one Babcock boiler).

A big economy in railway administration will be effected at the end of the week by the complete transfer to Doncaster from Chesterfield of the mineral traffic control of the Great Central section of the London & North-Eastern Railway. For many years the mineral traffic control of the Great Northern Railway was centred in Doncaster, and now the staffs and working of the amalgamated companies are to be co-ordinated in Doncaster, which is virtually the new capital of the South Yorkshire coalfield.

A contract has been concluded between a firm of British ore exporters and a group of German iron and steel producing firms, which includes Krupps, Mannesmanns, Klöckner, Gutehoffnungshütte, and Vereinigte Stahlwerke. The contract calls for 700,000 tons of Wabana ore in the first year, rising to 800,000 tons in 1930, to 950,000 tons in 1932, the maximum of 1,150,000 tons being reached in 1933. The price is fixed at 11s. 6d. per ton, plus freight charges from either Rotterdam or Emden, and holds good for all deliveries until September, 1933.

According to a cable from Cape Town three appointments have been made to the directorate of the Iron and Steel Corporation. They are Dr. H. J. van der Byl (chairman), Dr. A. J. Bruwer, and Mr. C. F. Delfos. The fourth member will very probably be Mr. Gundelfinger, of Durban. The Corporation is the outcome of the Iron and Steel Bill, which was passed by a joint session of both Houses of the Legislature on March 30, after having been twice rejected by the Senate. The Bill substitutes State control for State-aided private enterprise in the iron and steel industry, and makes Pretoria the centre of the industry.

The adjourned meeting of the 5 per cent. first debenture stockholders in the Barrow Hematite Steel Company, Limited, was last week further adjourned until August 14. Sir William B. Peat, one of the trustees, who presided, said that since the last meeting there had been meetings between the principal debenture holders and the company. The representatives of the debenture holders had declined to agree to any resolution involving a prior lien. At the same time, they had come to the conclusion that, if within seventeen days the board could produce a scheme for carrying on the business for twelve months, showing how finance would be arranged, the company, subject to the sanction of the stockholders, should be granted a moratorium in respect of interest until June 30, 1929, provided that the debenture holders should have such representation on the board as would enable them to demand a receivership if at any time during the moratorium they considered that the interests of the debenture holders were being jeopardised.

The sixth summer week-end conference of the Industrial Co-Partnership Association was held at Somerville College, Oxford, last week end. Representatives from the following firms were in attendance: Imperial Chemical Industries, Gas Light and Coke Company, South Metropolitan Gas Company, and the Brush Electrical Engineering Company. Amongst those taking part were Sir David Milne-Watson, Mr. Howard Hazell, and Mr. Frank Hodges, a member of the Electrical Commission.

Messrs. Thos. W. Ward, Limited, Sheffield, in addition to acquiring the controlling interest in the Ketton Portland Cement Company, Limited, registered last week as a limited company with a capital of £300,000, have now purchased the whole of the share capital in the North Lonsdale Tarmacadam, Limited, Ulverston, Lancashire. The output of the works is about 2,000 tons per week, and the Tarmacadam Company have control of the whole of the slag heaps of the North Lonsdale Iron & Steel Company, Limited, including the limestone, for road purposes.

New Companies.

Cons. Electrical Supplies, Limited.—Capital £100,000. Solicitor: A. R. Monks, Crown House, Aldwych, W.C.

Berrisford Engineering Company, Limited.—Capital £5,000. Permanent directors: W. H. Berrisford and S. Berrisford, Hesketh Avenue, Norton, Staffs.

British Colonial Engineering Company, Limited.—Capital £12,000. Solicitors: Grundy, Kewshaw, Samson & Company, 6, Austin Friars, London, E.C.

Wright & Platt, Limited, 52 and 53, Irving Street, Birmingham.—Capital £6,000. Pattern makers, etc. Directors: C. Wright (permanent director and chairman) and J. Cook.

Industrial Machinery Company, Limited, 58, Holborn Viaduct, London, E.C.1.—Capital £40,000 Directors: R. L. Paterson, A. Podmore, C. Tanner, A. J. M. Tuck and May L. Merrett.

Wyper & Engineering Supply Company Limited 89, Upper Thames Street, London, E.C.4.—Capital £4,000 in 3,500 £1 7 per cent. cumulative preference and 1,000 10s. ordinary. Directors: A. Cameron and A. E. White.

Fleet Castings, Limited.—Capital £1,000 in £1 shares, to carry on the business of brass and other metal casters, ironfounders, brassfounders, brassworkers, stampers and piercers, etc. Registered office: 148, Edmund Street, Birmingham.

Flextol Engineering Company, Limited, 18, Dartmouth Street, London, S.W.—Capital £6,000 in 5,000 £1 preference and 20,000 1s. ordinary. Directors: R. Terrell, C. S. Lewis, J. C. Todman, W. R. Clemens, R. J. Fletcher and H. Terrell.

W. Roberts & Company, Garston (1928).—Capital £20,000 (12,000 "A" and 8,000 "B" ordinary shares of £1), to acquire the business of copper smelters and rollers and copper and yellow-metal manufacturers and merchants lately carried on by W. Roberts & Company (Garston), Limited (in liquidation), at Crown Copper Mills, Window Lane, Garston, Liverpool. Registered office: Crown Copper Mills, Window Lane, Garston, Liverpool.

Contracts Open.

Buenos Aires, September 12.—113,000 kilogs. of bolts for various types of rails, 11,500 kilogs. of spring washers (Grover) for rail bolts, 25,500 kilogs. of fish-plates for various types of rails, 320,000 dogspikes, 1,200 clamp bolts for bridges, 60 sets of special bolts and washers for switches, 281 crossings, 290 points, 152 counter-points and other accessories, for the Argentine State Railways. The Department of Overseas Trade. (Reference A.X. 6586.)

The most recent official return of the Amalgamated Engineering Union shows a total membership of 219,615, with 1,546 branches.

Personal.

Mr. R. Gordon Sillars has been appointed a director of Messrs. Warner & Company, Limited, of Middlesbrough.

Mr. Tom Westgarth and Mr. F. J. B. Gardiner have been elected to seats on the board of Messrs. Richardsons, Westgarth & Company, Limited.

Mr. J. F. S. Ross, the principal of the Engineering Department of the Stockport Technical College, has been appointed to the position of principal of the Wigan and District Mining and Technical College. Before he went to Stockport in 1924 Mr. Ross served as lecturer in engineering at Barrow-in-Furness Technical College, and lecturer and deputy head of the Department of Civil and Mechanical Engineering at Loughborough College.

Wills.

Robinson, Arthur, Hinckley, engineer ...	£5,046
Gill, Thomas Raymond, Bath, formerly secretary of Stothert & Pitt, Ltd., engineers	£15,960
Ogden, Mr. Joseph, of Cedar House, Middleton Road, West Chadderton, Lancs, retired engineer	£12,579
Mr. Robert Ramsay Main, of Cairngower, Gordon Road, Crieff, N.B., of A. J. Main & Company, Limited, of Clydesdale Ironworks, Glasgow	£48,831

Company Meeting.

Midland Iron Company, Limited.—The annual meeting of the Midland Iron Company, Limited, was held at Masborough last week, Mr. A. Corker (managing director) presiding. He remarked that the cheaper Continental material which was being allowed to come into this country *ad lib*, and, consequently, to interfere with the demand, had reached such a volume in 1927 that it was sufficient to keep 15 works like theirs fully employed. He felt that the trade did not want any "nursing" by the Government; it only required to be dealt with fairly and squarely. No argument which had yet been used had, in his opinion, justified any Government permitting such a tremendous amount of foreign material to be imported free into this country, to the detriment of the industries concerned, to say nothing of the great suffering and unemployment which resulted. Orders were very scarce and difficult to obtain, with the result that the company had been employed to the extent of only about one-third of its capacity during the whole of the year. It was, however, some satisfaction to know that they had had their share of the work that had been going. The whole of the mill plant had now been electrified. Together with other industries, they were handicapped by excessive railway charges and local rates; in fact, the rates were five times the amount per ton to-day that they were in pre-war days, and he could not see that they were getting any compensating increased benefits. They were looking forward to relief in rates in the future. The position of the company had been fully realised by the directors, and drastic economies had been put into operation.

Reports and Dividends.

J. Samuel White & Company, Limited.—Profit, £3,097; reducing debit balance to £64,837.

Projectile and Engineering Company, Limited.—Interim dividend of 14 per cent., less tax, for half-year.

Herbert Morris, Limited.—Dividend for half-year to July 31, 1928, on 6 per cent. (less tax) and 5 per cent. (free of tax) cumulative preference shares.

Milners' Safe Company, Limited.—Dividend at the rate of 7½ per cent. per annum and a bonus of 2½ per cent. for the year ended May 31 are proposed.

W. H. Dorman & Company, Limited.—Net profit to March 31, £10,281. This profit has been deducted from the debit balance of £69,664 on profit and loss account brought forward, leaving £59,383 to carry forward.

Barry Graving and Engineering Company, Limited.—After payment of interest on debentures and an interim dividend on the preference shares there remains credit balance of £55,605. Directors recommend final dividend on preference shares, carrying forward £54,980.

Warner & Company, Limited.—Profit for year to June 30, 1928, £13,938; brought forward, £2,730; final dividend on ordinary shares at the rate of 20 per cent. (less tax), making 22½ per cent. (less tax); bonus of 1s. per share (less tax) on ordinary shares; carry forward, £3,022.

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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—The immediate outlook for the Cleveland iron trade continues unrelieved by even the faintest promise of relief from its present gloomy condition, and, indeed, the closing down of Messrs. Pease & Partners' Tees ironworks involves a further heavy decrease of production, much more significant than volumes of optimistic opinion on the prospects of future revival, founded apparently on the strength of the recent Government proposals of reduced railway rates for industrial fuel. There is, unfortunately, too much of the "jam to-morrow" promise suggested in the Chancellor's proposals for lightening the present burdens of the industry to inspire any reasonable ground for confidence in iron trade circles, and consequently markets remain, if possible, more despondent and deserted than for many years within recent experience. Export business is no worse than last month, but the total shipments abroad are negligible, and it is really the contraction in home industrial requirements which is at the root of the trouble. Nevertheless, prices are unaltered, as follow :—No. 1 Cleveland foundry iron, 68s. 6d. ; No. 3 G.M.B., 66s. ; No. 4 foundry, 65s. ; No. 4 forge, 64s. 6d.

In common with that of foundry material, consumption of hematite iron is extremely limited. But there are a few contracts to fulfil with Sheffield and South Wales steel makers, and there is still a small volume of trade with Italy. Tees-side makers are, however, less inclined to cut quotations, and in some cases are holding out for rather better prices. As much as 70s. per ton has in fact been paid for special brands, but ordinary mixed numbers can still be bought at 68s. 6d. per ton, and No. 1 quality at 69s. On the North-West coast prices are a shade weaker, Bessemer mixed numbers being quoted at 68s. 6d. per ton at works.

LANCASHIRE.—Consumptive demand for foundry pig in this area also is much below seasonal average, although, so far, sellers, with few exceptions, have maintained prices at about previous levels. Derbyshire furnaces are quoting at from 68s. to 68s. 6d., per ton, for delivery Manchester or equal distance, with Staffordshire qualities at slightly below this range, but it is unlikely that any maker would reject a fair-sized order for the sake of sixpence or so. For local delivery Cleveland makers are still adhering firmly to the 70s. level, with Scottish makes at from 67s. 6d. to 68s. per ton.

THE MIDLANDS.—Only a very moderate volume of business is reported in the pig-iron section at Birmingham this week, ironfounders mostly being content to follow the policy of buying small quantities for current consumption. It is reported that Derbyshire iron can be obtained below 60s., but the minimum figure for Northants is 55s. to 56s. North Staffordshire No. 3 commands the same levels as Derbyshire.

SCOTLAND.—With the local holidays still in force, practically no business is being done. More furnaces have been damped down, and there are now only ten operating in Scotland on all qualities. Prices are steady, and it is impossible to foresee any further reduction, as the makers are already losing money and finding costs moving against them.

Finished Iron.

Manufacturers of this class of material are experiencing increasing difficulty in securing fresh business, and many standing contracts expiring at mid-year, the outlook at the moment is far from hopeful. In the Midlands there is much competition for business in crown and the cheaper grades of iron, and the local works are having to compete with low figures quoted by Lancashire and other makers. Crown iron is offered at any price from £9, and nut and bolt iron at £8 12s. 6d. and upwards. Foreign No. 3 bolt iron is firmer in price, and the market tendency is still upward. This material is quoted delivered Black Country works at £6 13s. to £6 14s. 6d., and business is being done at these rates. Staffordshire marked bars remain at £12 at makers' works, but trade is very limited.

Steel.

The steel market continues inactive, although the higher prices which rule for Continental material keep home business at a rather better level than it might otherwise be At Sheffield there is a fair amount of buying of basic billets, but acid qualities are abnormally quiet. More than 50 per cent. of the open-hearth furnaces in this district are idle. Crucible steel demand is not good, but there is a big output of stainless and motor steel. Wire rod sales are on a smaller scale than of late. Quotations :—Billets : Siemens acid, £10 ; soft basic, £6 5s. ; semi-hard, £7. Business is quiet in the tinplate tared, and there is a little anxiety with regard to the volume of work available for next month. This has led to some weakness in the market and prices have eased to between 18s. and 18s. 3d. for coke tinplates basis.

Scrap.

In view of the existing depression in the principal consuming industries it is not surprising to find corresponding conditions in the markets for scrap material, and at Middlesbrough this week only a small tonnage of heavy cast iron could be disposed of at 61s., and on a very limited market machinery quality is unchanged at 66s. In Scotland most of the iron and steel works are again in a position to accept deliveries of scrap materials after having been closed for the annual holidays. Prices are more or less on the same level as they were prior to the holidays, and there is no indication of any weakening. Cast-iron scrap of all classes continues a drug on the market, and merchants find some difficulty in disposing of heavy machinery cast-iron scrap at 65s. to 66s. per ton, with few buyers, and for heavy ordinary cast, suitable for foundries, about 5s. per ton less. Light cast iron is unchanged at 57s. 6d. per ton. These prices are all per ton delivered f.o.t. consumers' works.

Metals.

Copper.—Although usually at this period of the year consumptive demand for base metals is inclined to slacken, with adverse effects upon prices, values of warrant copper have so far continued remarkably steady, and, if anything, indicate a slightly improved tendency. For this, of course, the confidence created by the American statistics for June is still largely responsible, and there can be little doubt that if, as is generally anticipated, consumptive demand shows a marked improvement with the close of the holiday season, quotations may be advanced considerably.

Closing quotations are :—

Cash.—Thursday, £62 15s. to £62 16s. 3d. ; Friday, £62 13s. 9d. to £62 15s. ; Monday, £62 13s. 9d. to £62 15s ; Tuesday, £62 13s. 9d. to £62 16s. 3d. ; Wednesday, £62 10s. to £62 11s. 3d.

Three Months.—Thursday, £63 2s. 6d. to £63 3s. 9d. ; Friday, £63 1s. 3d. to £63 3s. 9d. ; Monday, £63 2s. 6d. to £63 3s. 9d. ; Tuesday, £63 2s. 6d. to £63 3s. 9d. ; Wednesday, £63 to £63 1s. 3d.

Tin.—The position in the market for standard tin remains practically the same as when we last reported, with values just a shade firmer at the close. At the present time, however, the market remains largely under the influence of speculative interests, and notwithstanding indications of increasing world consumption, the volume of business passing outside that of professional dealings continues on a restricted scale. When definite information as to the relative growth of world production and consumption becomes available, it seems very probable that a position will be revealed justifying a substantial rise in tin values.

Official closing prices :—

Cash.—Thursday, £220 17s. 6d. to £221 2s. 6d. ; Friday, £216 10s. to £216 15s. ; Monday, £214 10s. to £214 15s. ; Tuesday, £214 to £214 5s. ; Wednesday, £215 5s. to £215 10s.

Three Months.—Thursday, £218 5s. to £218 10s. ; Friday, £214 15s. to £215 ; Monday, £213 to £213 5s. ; Tuesday, £213 5s. to £213 10s. ; Wednesday, £213 15s. to £214.

Spelter.—Business in this section of the market continues on the quiet side, due to the existing unsatisfactory statistical position. Some substantial arrivals have led to a certain amount of liquidation, and this, together with the continued low level of consumptive demand, has caused some depression, but quotations have remained firm, probably due to the continued strength of the American position.

Daily quotations are :—

Ordinary. — Thursday, £24 15s. ; Friday, £24 17s. 6d. ; Monday, £25 1s. 3d. ; Tuesday, £25 ; Wednesday, £24 11s. 3d.

Lead.—Values of soft foreign pig continue firm, and, in fact, show some upward tendency, although how far this movement is likely to continue it is difficult to say, particularly in view of the increased supplies which are now coming forward. Home demand is still rather spasmodic, the cable manufacturers calling for the most substantial supplies.

Closing prices :—

Soft Foreign Prompt.—Thursday, £20 18s. 9d. ; Friday, £20 18s. 9d. ; Monday, £21 ; Tuesday, £20 18s. 9d. ; Wednesday, £20 17s. 6d.

Patent Specifications.

The following list of Patent Specifications Accepted has been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full Specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The last numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

31,272. Siemens - Schuckertwerke Ges. Electric annealing furnaces. 262,800.

7,587. Marks, E. C. R. (Toledo Machine & Tool Company). Presses for drawing sheet metal. 292,256.

15,531. Rhodes, C. J. Presses for drawing sheet metal. 292,345.

27,532. Norddeutsche Affinerie. De-arsenifying ores and metallurgical products. 286,285.

28,021. Krupp Akt.-Ges., F. Method of raising the yield point of steel alloys. 282,015.

29,632. Hall, H. C., and Bradbury, T. F. Treatment of aluminium alloys. 292,407.

34,860. Roberts, E. W., and Temple, J. E. Casting or formation of bodies having hollow passages. 292,425.

1,255. Wack, J. J. Process and apparatus for the clarification of benzine. 292,433.

8703. Horton, S., and Horton, W. T. De-scaling of metal bars and the like. 293,112.

13237. Vereinigte Stahlwerke Akt.-Ges. Alloy steel for use as building material. 271,470.

21579. Hughes, E. S. B. Mackenzie-. Metal railway sleepers. 293,221.

23024. American Rolling Mill Company, and Tytus, J. B. Metal rolling. 293,229.

On Sale August 2.

32,680. Siemens Akt.-Ges., F., Durrer, R., Siemens, F. C., and Sprenger, A. Manufacture of steel in the Siemens-Martin furnace. December 24, 1926. 293,326.

9,081. Blamey, P. R. Extraction of metals from ores. 293,340.

13,713. Morris Motors (1926), Limited, Richardson, J. A., and Smart, R. A. Case-hardening or malleablising of iron or steel articles. 293,531.

16,321. Boulton & Paul, Limited, and North, J. D. Girders, spars and like members. 293,552.

8,858. Waskonig, W., and Bochumer Eisenhuttie Heintzmann Co. Ges. Appliance for bending rails. 287,851.

Goodwill in Industry.

Mr. J. G. Pearce, Director of the British Cast Iron Research Association, has been unanimously awarded by the judges the first prize of 100 guineas for a series of practicable proposals relating to "Goodwill in Industry." The competition was organised by the Glasgow and West of Scotland Association of Foremen, Engineers and Draughtsmen, and the judges represented the three parties in industry—the employer, the worker and the technical or administrative officer—being Sir Archibald Denny, the veteran shipbuilder and chairman of the British Engineering Standards Association; Mr. J. T. Brownlie, president of the Amalgamated Engineering Union; and Mr. John Holloway. Details respecting the publication of the Paper will be given at a later date.

Publication Received.

The Mond Nickel Bulletin, Vol. I, No. 1, July, 1928.—Published by the Mond Nickel Company, Limited, Victoria Station House, Westminster, London, S.W.1. This 24-page monthly bulletin contains abstracts of all recent literature appertaining to nickel and its alloys. It appears to be well up to date, as practically all the matter given relates to that published in June.

Empire Exhibition in Sydney.—It is reported that the proposal to hold an Empire Exhibition in Sydney in 1932 has been abandoned. Hostility to the project became manifest after the Prime Minister's recent second-reading speech on the Australian-British Empire Exhibition Bill in the House of Representatives.

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is the mushroom and which the toadstool?

Would you eat one to find out?

The correct answer is: "Don't be foolish; you wouldn't risk poisoning yourself eating either. Not when you can buy all the mushrooms you want, properly labelled."

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WEEKLY PRICE CURRENT.

COPPER.

	£	s	d.
Standard cash ..	..62	10	0
Three months ..	..63	0	0
Electrolytic	..68	15	0
Tough	..65	5	0
Best selected ..	..65	5	0
Sheets	..94	0	0
India	..76	15	0
Wire bars	..69	5	0
Do. August ..	..69	5	0
Do. September ..	..69	5	0
Ingot bars	..69	5	0
H.C. Wire rods ..	..73	5	0
Off. av. cash, July ..	..62	18	$4\frac{5}{23}$
Do. 3 mths., July ..	..63	3	9
Do., Sttlmnt., Jluy	..62	18	$3\frac{7}{11}$
Do., Electro, July ..	..68	18	$4\frac{10}{11}$
Do., B.S., July ..	..66	3	$7\frac{1}{2}$
Aver. spot price, copper, July	62	18	$4\frac{1}{2}$
Do., Wire bars, July	..69	3	5
Solid drawn tubes			13½d.
Brazed tubes			13½d.
Wire			10d.

BRASS.

Solid drawn tubes	11½d.
Brazed tubes	13½d.
Rods, drawn	10½d.
Rods, extd. or rlld. ..	7½d.
Sheets to 10 w.g. ..	10½d.
Wire	9½d.
Rolled metal	9½d.
Yellow metal rods	7½d.
Do. 4 × 4 Squares ..	8d.
Do. 4 × 3 Sheets ..	8½d.

TIN.

Standard cash ..	215	5	0
Three months ..	213	15	0
English	212	0	0
Bars	214	0	0
Straits .. (Nom.,	216	15	0
Australian .. (Nom.)	216	10	0
Eastern	215	10	0
Banca .. .. (Nom.)	217	10	0
Off. av. cash, July ..	212	10	$11\frac{13}{23}$
Do., 3 mths., July	209	14	$10\frac{7}{11}$
Do., Sttlmt., July	212	10	$2\frac{5}{11}$
Aver. spot, July ..	212	10	$11\frac{1}{2}$

SPELTER.

Ordinary	..24	11	3
Remelted	..23	10	0
Hard	..20	0	0
Electro 99.9	..29	0	0
English	..25	7	6
India	..21	5	0
Zinc dust	..33	0	0
Zinc ashes	.. 8	0	0
Off. aver., July ..	..24	19	$2\frac{5}{11}$
Aver., spot, July ..	..24	18	11

LEAD.

Soft foreign ppt. ..	..20	17	6
English	..22	5	0
Off. average, July ..	..20	15	$5\frac{23}{23}$
Average spot, July ..	..20	11	$11\frac{1}{2}$

ZINC SHEETS, &c.

Zinc sheets, English	..33	0	0
Do. V.M. ex whf.	..31	10	0
Rods	..39	0	0
Boiler plates	..29	0	0
Battery plates ..	..30	10	0

ANTIMONY.

Special brands, Eng.	..59	0	0
Chinese	..39	2	6
Crude	..33	10	0

QUICKSILVER.

Quicksilver	..20	17	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—			
25%	8	0	0
45/50%	12	5	0
75%	19	0	0
Ferro-vanadium—			
35/40%	..14/3 lb. Va.		
Ferro-molybdenum—			
70/75% c. free ..	..4/3 lb. Mo.		
Ferro-titanium—			
23/25% carbonless ..	1/2 lb.		
Ferro-phosphorus, 20/25%	£18	0	0
Ferro-tungsten—			
80/85%, c. fr.	1/3 lb.		
Tungsten metal powder—			
98/99%	1/7 lb.		
Ferro-chrome—			
2/4% car.	£30	0	0
4/6% car.	£21	0	0
6/8% car.	£20	10	0
8/10% car.	£20	0	0
Ferro-chrome—			
Max. 2% car.	£33	0	0
Max. 1% car.	£39	0	0
Max. 0.70% car.	£44	0	0
70% carbonless	1/2 lb.		
Nickel—99%, cubes or pellets	£175	0	0
Ferro-cobalt	9/- lb.		
Aluminium 98/99% ..	..£100	0	0
Metallic chromium—			
96/98%	2/8 lb.		
Ferro-manganese (net)—			
76/80%, loose	£13	15	0
76/80%, packed	£14	15	0
76/80%, export	£13	10	0
Metallic manganese—			
94/96%, carbonless ..	1/6 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0	2	3
Finished bars, 18% tungsten	£0	2	9

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over..	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to $\frac{1}{16}$ in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ¼ in.	3d. lb.
Do., under ½ in. × ¼ in. ..	1/-lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

Scrap from high-speed tool steel—

Scrap pieces	3d.
Turnings and swarf ..	1d.

Per lb. net, d/d steel makers' works.

SCRAP.

	£	s.	d.
South Wales—			
Hvy. steel	3	7	0
Bundled steel and shngs. ..	3 1 6 to 3	5	0
Mixed iron and steel ..	3 0 0 to 3	2	6
Heavy cast iron	3	19	0
Good machinery for foundries	3	2	6
Cleveland—			
Heavy steel	2	15	0
Steel turnings	2	8	6
Cast iron borings ..	2	3	0
Heavy forge	3	10	0
Bushelled scrap	3	2	6
Cast-iron scrap	3	1	0
Lancashire—			
Cast-iron scrap	3	0	0
Hvy. wrought .. .	2	17	6
Steel turnings	2	2	6

London—Merchants' buying prices delivered yard.

Copper (clean)	52	0	0
Brass	37	0	0
Lead (less usual draft) ..	18	0	0
Tea lead	16	0	0
Zinc	16	0	0
New aluminium cuttings..	68	0	0
Braziery copper	47	0	0
Gunmetal	47	0	0
Hollow pewter	150	0	0
Shaped black pewter ..	105	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	68/6
Foundry No. 3	66/6
Foundry No. 4	65/-
Forge No. 4	64/6
Hematite No. 1	69/-
Hematite M/Nos.	68/6
N.W. Coast—	
Hem. M/Nos. d/d Glas. ..	79/-
,, d/d Birm.	85/-
Midlands—	
Staffs. common*	67/6
,, No. 4 forge ..	57/-
,, No. 3 fdry... ..	60/-
Shrops. basic	—
,, Cold blast, ord.* ..	—
,, ,, roll iron* ..	—
* d/d Birmingham.	
Northants forge	52/6
,, fdry. No. 3 ..	55/-
Derbyshire forge	59/-
,, fdry. No. 3 ..	60/6
,, basic	60/-
Scotland—	
Foundry No. 1	75/6
,, No. 3	70/6
Hem. M/Nos.	74/-
Sheffield (d/d district)—	
Derby forge	62/6
,, fdry. No. 3 ..	64/6
Lincs. forge	62/6
,, fdry. No. 3 ..	64/6
E.C. hematite	79/-
W.C. hematite	84/-
Lines. (at furnaces)—	
Forge No. 4	58/-
Foundry No. 3	60/-
Basic	58/6
Lancashire (d/d eq. Man.)—	
Derby forge	—
,, fdry. No. 3 ..	68/-
Northants foundry No. 3..	—
Dalzell, No. 3(special)	100/- to 102/6
Summerlee, No. 3 ..	87/6
Glengarnock, No. 3 ..	87/6
Gartsherrie, No. 3 ..	87/6
Monkland, No. 3 ..	87/6
Shotts, No. 3	87/6

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.) nom.	9	10	0 to	10	15	0
Nut and bolt iron	8	12	6 to	8	17	6
Hoops			..	11	10	0
Marked bars (Staffs.) f.o.t.				12	0	0
Gas strip			..	11	10	0
Bolts and nuts, ½ in. × 4 in.				15	5	0
Steel—						
Ship plates..	8	7	6 to	8	12	6
Boiler plts... ..			..	10	10	0
Chequer plts. ..			..	10	12	6
Angles			..	7	17	6
Tees			..	8	17	6
Joists			..	7	17	6
Rounds and squares, 3 in. to 5½ in.			..	8	17	6
Rounds under 3 in. to ½ in. (Untested)			..	7	15	0
				and upwards		
Flats, over 5 in. wide and up				8	7	6
Flats, 5 in. to 1½ in.			..	7	17	6
Rails, heavy ..			..	8	10	0
Fishplates			..	12	10	0
Hoops (Staffs.) ..			..	10	0	0
Black sheets, 24g. ..				10	0	0
Galv. cor. shts., 24g. ..				13	10	0
Galv. fencing wire 8g. plain				12	10	0
Billets, soft	6	0	0 to	6	10	0
Billets, hard	7	2	6 to	7	12	6
Sheet bars			..	6	0	0
Tin bars			..	6	0	0

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	2½
Sheet to 10 w.g.	1	3
Wire	1	3½
Rods	1	3
Tubes	1	7½
Castings	1	2

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	per lb.
Ingots for raising ..	9d. to 1/3
Rolled—	
To 9 in. wide ..	1/3 to 1/9
To 12 in. wide ..	1/3½ to 1/9½
To 15 in. wide ..	1/3½ to 1/9½
To 18 in. wide ..	1/4 to 1/10
To 21 in. wide ..	1/4½ to 1/10½
To 25 in. wide ..	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/- to 1/8½
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila. ..	20.26
No. 2 foundry, Valley	16.75
No. 2 foundry, Birm.	15.50
Basic	17.76
Bessemer	18.76
Malleable	18.76
Grey forge	18.01
Ferro-mang. 80% d/d	105.00
O.-h. rails, h'y at mill	43.00
Bess billets	32.00
O.-h. billets	32.00
O.-h. sheet bars	32.00
Wire rods	42.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.85
Tank plates	1.85
Beams, etc.	1.85
Skelp, grooved steel	1.85
Skelp, sheared steel	1.85
Steel hoops	2.20
Sheets, black, No. 24	2.60
Sheets, galv., No. 24	3.50
Sheets, blue an'l'd., 9 and 10 ..	2.00
Wire nails	2.55
Plain wire	2.40
Barbed wire, galv.	3.20
Tinplates, 100 lb. box	$5.25

COKE (at ovens).

Welsh foundry	—
,, furnace	—
Durham and North.	
,, foundry	14/6 to 15/-
,, furnace	14/- to 14/3
Other Districts, foundry ..	—
,, ,, furnace (basis) ..	12/-

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes ..	20×14	box ..	18/3
,, ..	28×20	,, ..	36/6
,, ..	20×10	,, ..	27/3
,, ..	18½×14	,, ..	19/-
C.W.	20×14	,, ..	17/-
,, ...	28×20	,, ..	34/-
,, ...	20×10	,, ..	22/-
,, ...	18½×14	,, ..	15/9
Terneplates ..	28×20		34/- per box basis f.o.b.

SWEDISH IRON.

Bars, hammered, £17 10 0 to £18 10 0	
Rolled Ord. ..£15 0 0 to £15 10 0	
Nail rods .. £15 7 6 to £15 15 0	
Keg. steel nom. ..	..£32 to £35
Faggot steel nom. ..	£22 to £25
Blooms, according to quality	£8 to £12
Pig-iron .. £5 15 0 to £6 0 0	

all f.o.b. Gothenburg.

TUBES AND FITTINGS.

Up to and incl. 6 in.

	Tubes.	*Fittings.*
Gas	67½%	50%
Water	63½%	45%
Steam	60%	40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£ s. d.	
July	26 ..	62 15 0	dec. 3/9
,,	27 ..	62 13 9	,, 1/3
,,	30 ..	62 13 9	No change
,,	31 ..	62 13 9	,, ,,
Aug.	1 ..	62 10 0	dec. 3/9

Electrolytic Copper.

		£ s. d.	
July	26 ..	68 15 0	No change
,,	27 ..	68 15 0	,, ,,
,,	30 ..	68 15 0	,, ,,
,,	31 ..	68 15 0	,, ,,
Aug.	1 ..	68 15 0	,, ,,

Standard Tin (cash).

		£ s. d.	
July	26 ..	220 17 6	inc. 47/6
,,	27 ..	216 10 0	dec. 97/6
,,	30 ..	214 10 0	,, 40/-
,,	31 ..	214 0 0	,, 10/-
Aug.	1 ..	215 5 0	inc. 25/-

Tin (English ingots).

		£ s. d.	
July	26 ..	218 15 0	inc. 50/-
,,	27 ..	214 10 0	dec. 85/-
,,	30 ..	212 10 0	,, 40/-
,,	31 ..	212 0 0	,, 10/-
Aug.	1 ..	213 5 0	inc. 25/-

Zinc Sheets (English)

		£ s. d.	
July	26 ..	33 0 0	No change
,,	27 ..	33 0 0	,, ,,
,,	30 ..	33 0 0	,, ,,
,,	31 ..	33 0 0	,, ,,
Aug.	1 ..	33 0 0	,, ,,

Spelter (ordinary).

		£ s. d.	
July	26 ..	24 15 0	No change
,,	27 ..	24 17 6	inc. 2/6
,,	30 ..	25 1 3	,, 3/9
,,	31 ..	25 0 0	dec. 1/3
Aug.	1 ..	24 11 3	,, 8/9

Lead (English).

		£ s. d.	
July	26 ..	22 5 0	inc. 5/-
,,	27 ..	22 5 0	No change
,,	30 ..	22 5 0	,, ,,
,,	31 ..	22 5 0	,, ,,
Aug.	1 ..	22 5 0	,, ,,

AVERAGE MONTHLY PRICES OF STEEL BOILER PLATES IN ENGLAND.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1895 ..	5 15 0	5 15 0	5 12 6	5 12 6	5 15 0	5 17 6	5 15 0	5 17 6	6 0 0	6 0 0	6 2 6	6 0 0	5 16 10½
1896 ..	6 0 0	6 0 0	6 2 6	6 2 6	6 2 6	6 0 0	6 0 0	6 0 0	6 0 0	6 2 6	6 10 0	6 10 0	6 2 6
1897 ..	6 10 0	6 10 0	6 10 0	6 7 6	6 2 6	6 2 6	6 5 0	6 0 0	6 0 0	6 0 0	6 7 6	6 10 0	6 5 5
1898 ..	6 10 0	6 8 9	6 8 9	6 10 0	6 15 0	6 18 9	6 17 6	6 17 6	7 2 6	6 15 0	7 0 0	7 5 0	6 15 8½
1899 ..	7 5 0	8 0 0	8 2 6	8 2 6	8 5 0	8 5 0	8 12 6	8 12 6	8 15 0	8 15 0	9 2 6	9 5 0	8 17 8½
1900 ..	9 5 0	9 5 0	9 7 6	9 10 0	9 12 6	10 5 0	10 5 0	10 5 0	10 5 0	10 0 0	9 15 0	9 15 0	9 15 10
1901 ..	9 5 0	9 5 0	8 15 0	8 10 0	8 10 0	7 10 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	8 3 11
1902 ..	7 7 6	7 0 0	7 12 6	7 12 6	7 12 6	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 9 7
1903 ..	7 10 0	7 10 0	7 15 0	7 5 0	7 5 0	7 5 0	7 5 0	7 0 0	7 0 0	7 0 0	7 0 0	6 17 6	7 3 11½
1904 ..	6 12 6	6 15 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	6 18 11½
1905 ..	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 10 0	7 5 0	8 0 0	8 0 0	7 1 3
1906 ..	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 10 0	8 0 10
1907 ..	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 0 0	8 0 0	8 8 4
1908 ..	7 10 0	7 10 0	7 10 0	7 5 0	7 5 0	7 5 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 3 9
1909 ..	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	6 15 0	6 15 0	6 15 0	7 0 0	7 0 0	7 0 0	7 0 0	6 18 9
1910 ..	7 0 0	7 0 0	7 1 3	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 10 0	7 10 0	7 10 0	7 5 1
1911 ..	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 14 0	7 10 4
1912 ..	7 18 9	8 0 0	8 0 0	8 7 6	8 10 0	8 10 0	8 10 0	8 15 0	8 16 3	9 0 0	9 2 0	9 5 0	8 11 2½
1913 ..	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	8 19 0	8 15 0	8 5 0	7 15 0	7 15 0	8 17 0
1914 ..	7 15 0	7 15 0	7 15 0	7 13 9	7 10 6	7 5 0	7 0 0	8 0 0	8 2 6	8 5 0	8 5 0	8 5 0	7 15 11½
1915 ..	8 14 0	9 10 0	9 17 6	10 10 0	10 10 0	11 0 0	11 0 0	11 0 0	11 0 0	11 4 0	12 0 0	13 0 0	10 15 5½
1916 ..	13 0 0	13 0 0	13 0 0	12 15 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 12 11
1917 ..	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1918 ..	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1919 ..	13 0 0	15 0 0	15 0 0	15 0 0	19 5 0	19 17 6	21 0 0	21 10 0	21 10 0	21 10 0	21 15 0	23 10 0	18 9 9
1920 ..	26 0 0	28 0 0	28 5 0	28 10 0	29 5 0	30 0 0	30 0 0	30 0 0	30 10 0	31 0 0	31 0 0	31 0 0	29 9 2
1921 ..	30 5 0	29 0 0	25 0 0	25 0 0	23 0 0	21 0 0	20 10 0	19 0 0	17 10 0	16 0 0	14 16 0	22 1 9
1922 ..	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	13 1 8	13 10 0	12 15 0	12 10 0	12 10 0	12 10 0	12 6 0	13 10 9
1923 ..	12 8 9	13 6 0	14 0 0	14 0 0	14 0 0	14 0 0	13 12 6	13 0 0	13 0 0	13 0 0	13 0 0	13 10 0	13 9 1½
1924 ..	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	14 0 0	14 0 0	13 11 0	13 5 0	13 5 0	13 10 11
1925 ..	13 5 0	13 5 0	13 5 0	13 1 0	12 15 0	12 15 0	12 15 0	12 15 0	12 7 6	11 14 0	11 10 0	11 10 0	12 11 5½
1926 ..	11 10 0	11 10 0	11 10 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 6 3
1927 ..	11 5 0	11 5 0	11 5 0	11 5 0	11 2 6	11 0 0	11 0 0	11 0 0	10 16 0	10 10 0	10 10 0	10 10 0	10 19 0½
1928 ..	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	—	—	—	—	—	—

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

PIG IRON

REGISTERED TRADE MARK

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

19, ST. VINCENT PLACE, GLASGOW.

ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

TO Foundries and Engineering Companies contemplating Reorganisation.—Successful Commercial Director, with experience in all foundry business (costing, accountancy, production, sales, range of specialities, etc.), is open to consider offers in an advisory capacity on such matters.—Write in confidence to Box 778, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

TENDERS.

CITY OF SHEFFIELD.

The Lighting Sub-Committee of the City Council is prepared to receive TENDERS for the supply of LAMP PILLARS for the Lighting Department for the twelve months ending 30th September, 1929.

Particulars and Form of Tender, together with "Conditions of Contract," etc., may be obtained on and after Saturday, 28th July, 1928, on application to the Lighting Engineer, 42, Corporation Street, Sheffield.

Tenders to be enclosed in the official envelope provided, endorsed "TENDER FOR LAMP PILLARS," and delivered not later than Wednesday, 8th August, 1928.

The Committee do not bind themselves to accept any TENDER.

Any person or firm sending in a Tender will be required to add a schedule to such Tender stating the names of the various classes of labour which he or they intend to employ, together with the places where such labour will be employed, and the rates of wages, hours of labour and the conditions of employment to be paid and observed in respect of each class of labour, all of which as shown in such schedule shall comply with the City Council's form of clauses respecting wages, hours, and conditions of labour, and prohibition against assigning or sub-letting, a copy of which in the "Conditions of Contract" will be furnished with the Form of Tender.

J. F. COLQUHOUN,
Lighting Engineer.

Public Lighting Engineer's Office,
42, Corporation Street, Sheffield.
23rd July, 1928.

PATENTS AND TRADE MARKS.

PATENT RIGHTS required for U.S.A. and Canada of any good patented article applicable to any branch of Engineering; advertiser, now in London, will be willing to negotiate for the exclusive rights for U.S.A. and/or Canada.—Box 770, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PUBLICATIONS.

Now ready. Exact Position To-day of Machinery with Regard to Rating.

RATING OF MACHINERY AND PLANT IN ENGLAND AND WALES, JULY, 1928. By John Scott Henderson, B.Sc. Lond., Barrister-at-Law. Price 5s.—"RATING AND INCOME TAX," 1, Dr. Johnson's Buildings, Temple, E.C.4, or Argus Press, Tudor Street, E.C.4.

RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. The new 1928 edition is now on sale. Price 42s. net, bound in cloth.—Published by INDUSTRIAL NEWSPAPERS, LTD., 49, Wellington Street, Strand, London, W.C.2.

MACHINERY.

WANTED, Cupolette, 24-in. diameter casing, with or without fan.—HYDE, Abbeydale Steel Foundry, Sheffield.

SAND MIXERS.—New and second-hand. Ask us to quote.—W. BREALEY & COMPANY, LIMITED, Prospect Works, Hawksley Avenue, Sheffield.

FOR SALE. Second-hand Moulding Machine for all classes of work, hand and power.—Apply Box 768, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

New Cylindrical Grinding Machine; grinding capacity 4 ft. 1 in. long, 11¾ in. dia

Nearly New LANDIS Plain Cylindrical Grinding Machine, 12 in. x 42 in.

DIAMOND Surface Grinding Machine, with Magnetic Chuck 2 ft. 8 in. x 10 in.

Vertical Rotary Surface and Ring Grinder, with 12 in. dia. magnetic chuck; wheel, 8¾ in. dia.

3 ft. gauge, 4-wheel, 7 in. LOCOMOTIVE (Kerr Stuart), 0—4—2 type; steel firebox; 160 lbs. W.P.

2 ft. 6 in. gauge, 4-wheel, 7 in. LOCOMOTIVE (Bagnall); steel firebox; 150 lbs. W.P.

One good second-hand WATER-TUBE BOILER, by Babcock & Wilcox, Ltd.; steam drum, 22 ft. long overall x 3 ft. 6 in. diam.; reinsurable at a working steam pressure of 180 lbs. per square inch.

Two LANCASHIRE BOILERS, 30 ft. x 8 ft.; reinsure 110 lbs. pressure.

18,000 ft. of NEW 2 in. diam. Screwed and Socketed Piping, in lengths of about 18/21 ft. to British Standard Specifications and tested to 270 lbs. hydraulic pressure.

CATALOGUE (10,000 Lots) ON APPLICATION.

THOS. W. WARD LTD.,
ALBION WORKS, SHEFFIELD.

MUST BE MOVED. PRACTICALLY NEW. BARGAINS.

By PNEULEC COMPANY.

ELECTRICALLY-OPERATED JAR-RAM MOULDING MACHINE, with MOTOR.

36 Pairs of Special MOULDING BOXES, for 12-ton latest specification Standard Split Axle Boxes.

36 Core Plates.

Cast-iron Pattern Plates with Mahogany Patterns and Core Boxes.

No. 4 Gas-fired Core Stove, 6 ft. x 9 ft. x 3 ft.; two compartments with thermometers.

FRANK JONES,
CAERAU CRESCENT, NEWPORT, MON.

FOUNDRY REQUISITES

Try our REFRACTORIES.

Ganister or Silica Bricks and Blocks (any shape or size) **Sands, Cements, Ganister.**—*Let us have your enquiries*

THE CLEVELAND MAGNESITE & REFRACTORY CO., LTD.
Normanby Brickworks, Normanby, Eston, Yorks.

MISCELLANEOUS.

INFORMATION is desired regarding the centrifugally casting of white metal bearings directly into Connecting Rods.—Box 776, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

CHARCOAL.—Powdered, granulated, lump, blacking; inquiries invited.—J. BUCHANAN & COMPANY, Ashfield Road, Altrincham, Cheshire.

GANISTER, best quality, for Cupolas, also for Steel Works.—ASTBURY SILICA COMPANY, "The Brooms," Park Lane, Congleton.

W.O. "PEERLESS" SPECIALITIES.—Fluxes for Brass, Gunmetal and Aluminium; Metallic Cement; Parting Powder, Liquid Core Sand Binder; all best and cheapest.

WILLIAM OLSEN, LIMITED,
COGAN STREET, HULL.

CHARCOAL.—Best Hardwood, Lumps and Chips, quoted for carriage paid terms.

WILLIAM OLSEN, LIMITED,
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